Three Essays on the Economics of the Family: Empirical Evidence from India

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Declaration

I hereby declare that this thesis has not been, and will not be, submitted in whole or in part to another University for the award of any other degree. I affirm that all the material presented in this thesis is original work that I have undertaken with guidance and input from my supervisors. The fourth chapter of this dissertation is co-authored with Dr. Sugata Bag, University of Delhi, India and Dr. Suman Seth, Leeds University Business School, UK. I have used primary data collected by my co-authors for the relevant study. I have contributed towards the selection of precise econometric methodologies, data analyses and writing the chapter independently. Needless to mention, I bear the full responsibility for all errors or omissions.

Signature:

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Summary

Developing countries face many socio-economics challenges, such as (i) low level of educational and poor health attainments of children, (ii) low rate of female labour market participation, (iii) lack of access to basic amenities for living among urban slums-dwellers (iv) discrimination by caste, religion and ethnicity in socio-economic aspects of life and many more. This thesis empirically investigates some of these challenges in the Indian context.

Chapter 2 revisits the child quantity-quality trade-off model formulated by Becker and Lewis in 1973 and it empirically examines whether child-quantity is inversely related to child-quality. I use the 2011 India Human Development Survey dataset, consisting of a nationally representative survey of Indian households and an instrumental variable approach to control for an endogenous child-quantity variable (i.e., the number of children born per woman). Using *twins* as an instrument for child-quantity, the findings reveal that the negative impacts of having a large family size on schooling outcomes are relevant to the urban settlement and the nuclear family setting. These negative impacts on the average schooling outcomes primarily emerge from families that have five or more children. The impacts on health outcomes are relevant to the rural settlement and to both the extended and the nuclear family settings. Chapter 3 investigates the impact of fertility on female labour market outcomes. I use the same dataset and an instrumental variable approach to instrument an endogenous fertility variable. Using *twins* and *first-born girl* as instruments for fertility, the findings reveal that fertility discourages female labour market participation and longer hours of labour supply, particularly when children are young (under the age of six). Economic variable, such as hourly wage encourages female labour market participation as well as working for longer hours in the labour market, irrespective of age categories of dependent children. However, unearned family wealth discourages female labour market participation and working for longer hours in the labour market. Moreover, the female labour participation is higher among the disadvantaged households, such as Schedule castes and Schedule Tribes. This is because the economic condition of the households is extremely poor and it is particularly so for the similar households that are living in the slums and are deprived of many government benefits for not possessing a caste certificate. In Chapter 4, therefore, I examine the impact of the possession of a caste certificate on the standard of living of socio-economically disadvantaged *eligible* households residing in the slums of two Indian cities, namely Mumbai and Kolkata. I use the slum-level dataset that has been collected as a part of the NOPOOR project in 2013-14, funded by the European Commission, and an instrumental variable approach to control for the endogeneity in the possession of a caste certificate. The *state of residence status* (i.e., whether an *eligible* household is residing within its state of origin) is used as an instrument for the possession of a caste certificate. The findings reveal that the possession of a caste certificate improves the standard of living for the *eligible* households compared to the similar households that do not possess one, this is relevant for Other Backward Class households. The positive impact of the possession of a caste certificate on an *eligible* household's standard of living is mediated through the procurement of government jobs by at least one household member.

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Chapter 1. Introduction

The United Nations have globally made significant strides to advance the right to education and to improve access to basic services for sustainable development. Several policies have evolved over time to meet the goals of economic development and social inclusion in developed and developing countries. For example, education policies have evolved to provide universal education in many developing countries. Welfare policies have evolved to make the European countries most competitive and the most dynamic knowledge-based economy in the world. Broader targets (at macro-level) are achieved through closer focus on micro-level aspects of an economy, such as improving children's educational attainments, increasing female labour market participation, promoting equality of opportunity and achieving a higher standard of living for all. For example, Esping-Andersen et al. (2002) explain that taxation policies in Europe have been able to increase the number of tax payers and broaden the tax base of the economy through increase in female labour market participation which has also contributed to an increase the productivity of a nation. Despite the implementation of such welfare policies in many countries, both developed and developing countries continue to experience several challenges in the form of low female labour market participation, gender gap in wages, poor education and health of children due to a large family size, discriminations based on ethnicity, religion and caste and many more. It is therefore essential to investigate some of these challenges and understand the determinants of such outcomes. Such evaluations are very crucial for evidence-based policy making.

India is not the exception to these challenges. Since 1970, the education of children has been one of the long-term socio-economic development goals of the Government of India. However, there still exits an enormous gap between school enrolment and educational attainment of children. Net enrolment rate at upper primary level is far from being satisfactory, and dropout rates continue to be a major concern at all levels of education (G.o.I, 2012). There could be several key factors influencing such low educational attainments of children; these include lower educational attainments of parents, child-labour in financially disadvantaged families, large number of children in a family, caste, religion and the social and cultural norms. By controlling for these crucial factors, I investigate whether family size (i.e., the number of surviving children residing with a woman) influences schooling and health outcomes of children. Dating back to 1969, studies have found that family size could negatively impact on children's educational attainments. In the context of India, Rosenzweig and Wolpin (1980b) study provides such evidence. Even today, the negative effects of having more siblings on schooling and health outcomes of children persist in India and is confirmed by Pande (2003b), Sarin (2004), Asfaw et al. (2010), Kumar and Kugler (2017), Makino (2018), Zimmermann (2012). This observed negative relationship between the number of children and quality of children is popularly known as the quantity-quality trade-off theory (Q-Q theory) that has been originally formulated by Becker (1960). Earlier empirical findings in the Indian context support the prediction of Becker's Q-Q theory.

Despite these novel contributions in the Q-Q literature, there are still some gaps in the literature where I contribute some key features. *First*, unlike the earlier studies, I have consistently used all three child-health outcomes, for all age groups of children (1–4 and 5–18), namely z-scores for weight-for-age, height-for-age and BMI-for-age, in addition to the traditionally used schooling outcomes (year of education and age-standardised schooling index). Furthermore, I use three additional measures of schooling outcomes, namely school attendance, delay in school and ratio of actual years of schooling to expected years of schooling. Second, unlike Kumar and Kugler (2017), I have used twins to control for the endogeneity in child-quantity. For a causal analysis, Kumar and Kugler (2017) have used *first-born girl* as an instrument for child-quantity. However, the *first-born girl* may have a direct impact on siblings' schooling attainments because an older sister in a family often takes care of the educational responsibility of her younger siblings. An empirical test in my study supports this prediction; first-born girl is positively correlated with her siblings' years of schooling completion, which weakens the validity of the instrument for the given sample in my study.

I have used twins instead of a *twin-ratio*, which has been used by Rosenzweig and Wolpin (1980b). This is because *twin-ratio* is endogenous by its definition; twin-ratio is defined as the number of twin births divided by the number of pregnancies per woman and hence, the denominator remains an endogenous variable. I use an alternative instrument i.e., *same gender composition of first two children* to examine the robustness of the results. *Third*, a family that experiences twin births at the first delivery may have different characteristics which may influence children's outcomes differently compared to a family that experiences twin-births in the latter deliveries. To examine how this kind of heterogeneity across families may influence children's schooling outcomes, I study the impact of n^{th} delivery of twins on schooling outcomes of all previous born children, following the study by Black et al. (2005). *Fourth*, I study the impact of siblings on schooling and health outcomes based on a dichotomy between an extended family and a nuclear family setting. *Finally*, I have tried to address the birth spacing concern (i.e., a closer birth spacing between children is likely to have a negative impact on previous born siblings' education) by controlling for age gap between the first- and last-born children. When the age gap is high, the first-born child is likely to take care of his/her younger siblings' education; this potentially controls for negative effects of zero birth spacing of twins. Similarly, contraceptive use by either of the parents is used as an alternative control variable to examine the robustness of the results.

I have used the 2011 India Human Development Survey (IHDS-II) for this study. This is a nationally representative dataset and covers all 28 states and 5 union territories of India, excluding 2 union territories, namely Andaman and Nicobar Islands and Lakshadweep. The primary reason for selecting this dataset over the National Family Health Survey (NFHS) and National Sample Survey (NSS) is that IHDS has health information on children for all ages between 0–18 while NFHS has health information for children below the age of 5. NSS does not have health information. In addition, IHDS-II is a comprehensive dataset that includes a wide variety of questions relating to socio-economic conditions of the households, such as educational status, employment, income, consumption expenditure and social capital.

The empirical findings show that the negative impacts of having a large family size on completed years of schooling and ERT are relevant to the urban settlement and the nuclear family setting. The regression models based on different family sizes reveal that these negative impacts of child-quantity on the schooling outcomes of children primarily emerge from the families having at least five children. The impacts on the health outcomes are relevant to the rural settlement and to both the extended and the nuclear family settings.

In Chapter 3, I investigate whether child-quantity also influences female labour market participation and hours of labour supply using the 2011 IHDS dataset. The motivation behind this study emerges from the fact that female labour market participation rate in India has been 37% in 2005 and it has continued to decline gradually thereafter, remaining close to 25% in 2011-12 (see Figure 3.1). The 2011 IHDS dataset also reveals that female labour market participation rate is 25% (see Table 3.2) while the the average number of surviving children per woman during 2011-12 has been four. These children were born during the 1990s, when the live birth per woman was 3.8 (see Appendix Table A2.3). These estimates provide a scope for further investigation into the research question: whether a large number of children per woman, during 2011-12, have negative impacts on female labour market outcomes, particularly in presence of least one child below the age of six.

There is a vast literature in labour economics over the past 20–30 years questioning why women are under-represented in the labour market in both developed and developing countries. Among several factors, an observed fact that women disproportionately assume child-rearing responsibilities has always been recognised in the labour economics literature (Waldfogel, 1998; Piras and Ripani, 2005). The related studies in the past have tried to explore several factors (such as fertility and unearned family wealth) that discourage female labour market participation. The studies have also investigated how an incentive, such as a wage rate influences female time-allocation in different activities, such as housework, market-work and leisure. This broad division of time into the three types of regular activities is known as the *trichotomy of time allocation* in the literature.

The theoretical study on the *trichotomy of time allocation* by married women has been motivated by Gronau (1977). Gronau assumes that, in a developed country setting, a woman may choose to spend *zero* hours at home and may allocate her time between market-work and leisure. I modify this assumption in my work to reflect a more realistic context. I assume that a woman spares some compulsory minimum amount of time at home such that hours spent at home is strictly positive, instead of a *zero* possibility. Hence, I have refined Gronau's original proposition on a woman's equilibrium allocation of hours into house-work, market-work and leisure by introducing an additional time-constraint: *compulsory house-work time requirement*. By incorporating the constraint into the model, I show how the optimal hours of labour supply in the market may decline below the Gronau-equilibrium hours of labour supply. Moreover, depending on the relative magnitude of a shift in the constraint (i.e., *compulsory house-work time requirement*) from its reference point due to an exogenous shock, for example a fertility shock, there could be a possibility of a *sub-optimal* solution that may cause a working woman to exit the labour market. Following the theoretical demonstrations, I empirically investigate whether the exogenous fertility shock has negative consequences on female labour market outcomes, namely participation and hours of labour supply in the market. Due to the endogenous nature of fertility decisions, I have used two instruments for fertility, namely *twin-births* (i.e., whether or not a mother has twins), following Bronars and Grogger (1994) and *first-born girl* (i.e., whether or not the first-born child is a girl). A causal analysis in this area of research has not been done earlier in the Indian context. Using the IHDS-II dataset and twins, the primary findings reveal that fertility discourages female labour market participation and longer hours of labour supply, particularly when children are young (below the age of six). The negative impact of young children on female labour market participation is evident in the urban area and in the nuclear family setting. The negative impact of young children on hours of work in the market is relevant to both the types of settlement (urban and rural) and to both the types of family setting (extended and nuclear). In contrast, school-aged children encourage women's labour market participation although they have null effect on women's average hours of labour supply. In addition to my primary focus on the fertility impact, the study examines the impacts of hourly wage and family wealth on the outcomes; the findings are consistent with the theoretical predictions of Blundell and MaCurdy (1999), which are typically relevant for a developed country context. Culture also plays a crucial role in determining female labour market outcomes in India, where social discrimination persists across the caste hierarchy. The caste system in India has two distinct concepts–the varna system (that divides the ancient Hindu society) and the jati system (that determines the contemporary social code). The link between varna and jati is discussed in greater length in Chapter 4. In the contemporary society, the exact number of jati is not known with certainty but the count is approximately 7,000 (Deshpande, 2013). The need for the Affirmative Action Programme divides the population in the available national data (such as the National Sample Survey (NSS)) into four broad groups:(i) Schedule Caste (SC: who are known as ex-untouchable jatis and several members of this ex-untouchable jatis self-identify themselves as 'Dalit'), (ii) Schedule Tribe (ST: This group mostly comprises of tribal people, but more specifically geographically isolated groups of people. So, some non-tribal people are also included in this category, particularly those residing in the hills (includes 'Himachali Brahmins')), (iii) Other Backward Class (OBC: a heterogenous collection of Hindu low caste, some non-Hindu communities, and some tribal communities who are not included in ST category), (iv) Others or General (the residual of the population that is further divided into two groups: Brahmins and Forward Class (includes all religions)). SC, ST and OBC are the disadvantaged groups because they often trail behind in various socio-economic outcomes, namely consumption, education, health and employment. Empirical findings in the chapter reveal that the likelihood of female labour market participation is higher (lower) among SC and ST (Brahmin and Forward Class) women compared to OBC women. This is reasonable because SC and ST households experience the worst living conditions in the urban slums and in the rural areas. Affirmative Action (AA) Programme in India intends to raise the likelihood of representation for the historically oppressed caste (SC) and tribal minority (ST) groups through obtaining a government job or getting into academic institutions (school/college). Belonging to the said communities does not automatically enable the members to benefit from the various central and state AA schemes. Rather, these disadvantaged groups are required to have a caste certificate from the government of their native state domicile. It is therefore crucial to investigate whether the possession of a caste certificate by the *eligible* households makes any difference to their living standard compared to similar *eligible* households that do not possess one.[1] This question is more relevant in a slum-setting, where the households experience the worst socio-economic condition; this is investigated in Chapter 4.

Chapter 4, examines whether the possession of a caste certificate by an *eligible* member of a slum-dwelling household improves the household's standard of living compared to similar *eligible* households that do not possess one. This slum-level study is a novel contribution to the literature on AA programmes and socio-economic well-being of disadvantaged groups of people in the India. We have used uniquely collected dataset comprising of 1,361 households residing in the urban slums of Mumbai (a city in the state of Maharashtra) and Kolkata (a city in the state of West Bengal). This slum-level dataset has been collected as a part of the NOPOOR project in 2013-14, funded by the European Commission. Mumbai and Kolkata have larger shares of population residing in slums (i.e., 41.8% and 31.4% respectively) among all other Indian cities. Due to the endogeneity in the status of caste certificate holding, an instrumental variable approach has been used. *Original state of residence* (i.e., whether a household is residing within its *state of origin*) is used as an instrument for the possession of a caste certificate. Residing in the state of origin is positively correlated with the caste certificate possession because the certificate can be only issued from the state of origin, if an *eligible* candidate registers for one and it can be used within the same state. The findings in this study reveal that the possession of a caste certificate improves the standard of living of

[1]For one to be *eligible* for a caste certificate, a beneficiary's caste must be listed in the central or a state government's list of identified caste groups (or jatis) that are broadly classified into SC, ST and OBC.

the *eligible* slum-dwelling households compared to similar *eligible* households that do not possess one. Such a positive impact of a caste certificate on the standard of living of the *eligible* households is mediated through government job positions held, potentially through a reservation channel, by at least one member per households. The impacts are predominantly relevant to OBC households.

The structure of this thesis is summarised as follows. Chapter 2 revisits the Q-Q theory originally formulated by Becker (1960) and empirically examines whether such a trade-off exists in India using the 2011 IHDS, a nationally representative dataset. I fill some of the gaps in the literature by measuring child-quality using both education and health outcomes for all age groups of children (1–4 and 5–18) and by considering several instruments for child-quantity, namely *twin births*, n^{th} *delivery of twin births*, *same gender composition of first two children*. This chapter also examines the impact of child-quantity on child-quality based on a dichotomy between an extended and a nuclear family setting. Chapter 3, contributes to the labour economics literature, theoretically, by revising the original Gronau-equilibrium time allocation by a woman. Following the theoretical demonstrations, I have empirically examined the causal impacts of the exogenous fertility shock on female labour market outcomes in the Indian context using the same dataset. Chapter 4 examines whether the possession of a caste certificate by an *eligible* member of a slum-dwelling household improves the household's standard of living, compared to similar *eligible* households that do not possess one. This study also investigates whether such a benefit of a caste certificate is mediated through the procurement of government jobs by at least a member of the *eligible* slum-dwelling household. Chapter 5 summarises the key findings of this thesis before discussing the limitations of this work and suggesting potential avenues for future research.

Chapter 2. Child Quantity-Quality Trade-off Revisited: Evidence from India

2.1. Introduction

Improving educational attainments of children in India has been one of the long-term goals since the initiation of several education policies by the Government of India (G.o.I) in the 1970s. Despite the initiation of the recent Right to Education (RTE) Act of 2009, there has continued to exist an enormous gap between school enrolment and schooling attainment of children. According to the Statistics of School Education report (G.o.I, 2014), the drop-out rates in 2011-12 at Primary (Classes 1–5), Elementary (primary level: Classes 1–5 and upper primary level: Classes 6–8) and Secondary (Classes 9–10) levels have been 22.3%, 40.8% and 50.3% respectively. Despite the initiation of the RTE Act in 2009 these high drop-out rates are not surprising because it generally takes a considerable amount of time for a government programme to be effectively implemented on a wider section of society. Thus, such an act is likely to have an impact on the sample of young children who were born around 2009, rather than on those children who were born in the 1990s.[2] In addition, although 100% enrolment of the children in schools has been achieved but this has not guaranteed high quality of school education for all the children in India. Therefore, an education policy needs to focus on the quality of schooling, which has been emphasised by Kingdon (2007), rather than solely focusing on increasing school enrolment of the children. In addition, health of children, which is a crucial driver for educational performance of children, has also been a subject of concern in many developing countries including India. The economic value of preventing child malnutrition has been the subject of investigation in the economics literature starting from Strauss (1986) to Scholte et al. (2016) and Singh and Masters (2017). It is equally important to investigate the cause for such malnutrition and poor schooling attainments of

[2] In this study, I look at the schooling performance of 5–18 year old IHDS-II children. The IHDS-II children, who are within the age range of 5–18 are less likely to be impacted by the RTE Act of 2009 (as these children have already started schooling having being born in the 1990s) than the children who are within the age range of 0–4 (as these children are expected to start schooling after the implementation of the RTE Act.

children. There could be several factors that may influence poor educational attainment and malnutrition of children in developing countries, such as a large family size, lower educational attainments of parents, child labour in economically poor households, differences in socio-cultural norms, such as a practice of discrimination by caste or religion that are likely to deprive children from getting admission to schools and have access to health facilities due to a parental caste background and many more reasons. This chapter primarily focuses on one of these reasons and investigates whether a large family size (measured by the number of surviving children per mother) has causal impacts on schooling and health outcomes of the children.

To motivate this research question on child quantity-quality trade-off, it is essential to understand the empirical pattern of the relationship between a large family size and child-quality and also the theory behind the observed pattern? Let's first look at the observed relationship across the states of India. The 2011 India Human Development Survey (IHDS-II) dataset reveals that the states where families have on average two children per woman have higher schooling attainments of children compared to the states where families have on average three or four children per woman (refer to Appendix Table A2.4).[3] Thus, the association between family size and schooling attainment of children across the states appears to be negative for both the age groups of children: 5–14 (i.e., the ages that are consistent with primary and secondary levels) and 15–18 (i.e., the ages that are consistent with higher secondary level). Previous research studies have tried to provide a theoretical explanation for the observed negative relationship by underscoring the fact that a resource-constrained household with a large family size will not have enough resource to invest in each child's human capital (Kumar and Kugler, 2017; Becker and Lewis, 1973). In other words, when the number of children increases, the marginal cost of investment in each child's quality (i.e., in education and health) increases in a resource-constrained household. This increase in marginal cost of investment in each child's quality makes children more expensive to parents; it discourages parents from

[3]The state-wise fertility rate per woman is presented in Appendix Table A2.5.

making higher investment in each child's human capital, causing this trade-off. This notion is popularly known as the child quantity-quality (Q-Q) trade-off in the economics literature. Thus, the Q-Q trade-off implies that the parental decisions regarding child-quantity and child-quality cannot be made in isolation. In addition, the confounding nature of parental fertility decisions makes child-quantity an endogenous variable, which complicates a causal inference. An empirical testing of this theoretical notion is therefore challenging and is of policy relevance.

To proceed with the empirical testing of the Q-Q theory, two things remain crucial for the analysis. First, how child quality can be measured? Second, how to control for the endogeneity of child-quantity for drawing a casual inference? This study therefore revisits the existing literature to understand how child-quality has been measured. Some studies have used education as the sole measure of child-quality while others have used either health or both education and health to measures child-quality. For example, in the context of China, Liu (2014) has used school enrolment, middle school graduation status, normalized years of schooling and height-for-age as child-quality measures. Liu finds that the Q-Q trade-off is weaker when quality is measured by educational attainments of children, whereas a stronger trade-off is observed when quality is measured by height of children. He therefore concludes that by focusing solely on one specific dimension of child-quality, one may arrive at a misleading conclusion on the overall Q-Q trade-off. The existing studies, in the Indian context, have used the following education indicators for measuring child-quality, such as years of schooling, ever attended school, whether currently enrolled and age-standardise schooling index. Although, several schooling indicators has been used by Azam and Saing (2018) that are directly available from the IHDS-II dataset, I use some new indicators for schooling outcomes. Besides, child-health has not been studied consistently using all the three health indicators (i.e., z-scores for weight-for-age, height-for-age and BMI-for-age) and for all the age groups of children (i.e., 1–4 and 5–18), which provides a scope to fill the existing gap.[4]

[4]Although in an unpublished doctoral dissertation, Sarin (2004) uses quality indicators, such as height-for-age

Following these previous studies and using IHDS-II dataset, I have constructed a wide-ranging indicators for measuring child-quality. For schooling outcomes of children between the ages of 5–18, I have used the following indicators: a) *completed years of schooling*; b) *school attendance* if a child is currently enrolled in school (binary variable); c) *delay in years of schooling* if a child is currently enrolled in school (binary variable); d) *ratio of actual years of schooling to expected years of schooling* at a given age (ERT); e) *age-standardised schooling index* (EDT); f) *test scores in reading, writing and arithmetic*, the score categories are available for children between the ages of 8–11 and are converted to binary variables. The child health indicators are assessed in accordance to child growth standards of World Health Organisation (WHO) and they include i) *weight-for-age z-score*, ii) *height-for-age z-score*, iii) *BMI-for-age z-score*. I have used two different age groups of children i.e., 1–4 and 5–18 to analyse the sibling impact on health outcomes.

To control for the endogeneity of child-quantity variable, I have used an instrumental variable approach where twins (i.e., whether a mother has surviving twin-children or not) is used as an instrument for child-quantity. This instrument has been used in several studies in the context of both developing as well as developed countries (Rosenzweig and Wolpin, 1980b; Angrist et al., 2005, 2010; Black et al., 2005, 2010; Caceres-Delpiano, 2006; Dayioglu et al., 2009; Fitzsimons and Malde, 2014; Li et al., 2008; Sanhueza, 2009; Ponczek and Souza, 2012). Using twins, the findings reveal an extra child in a family, on average, lowers the completed years of schooling by 0.12 years, reduces the chances of school attendance by 3.6 percentage points, and it reduces the ratio of actual years of schooling to expected years of schooling by 0.02 of a unit. These findings are robust to birth order of children. In the aspect of heath,

z-score, height-to-weight ratio and immunisation (i.e., chance of receiving Measles vaccine) for below five-year-old children born during the 1990s from Demographic Health Survey datasets (DHS). He has not studied the health outcomes for school-aged children. Azam and Saing (2018) have only used height-for-age z-scores for 6–18 year old IHDS-II children but not for those who are below 5 years. Besides weight-for-age is also an important indicator of a child's health in the initial years of birth. In addition, these studies have neither examined heterogeneity in the Q-Q trade-off by types of family setting (i.e., extended versus nuclear) nor used all the health indicators consistently for all age groups of children, which provides further scope for research that is undertaken in this study.

the children between the ages of 5–18 experience a loss of 0.23 of a standard deviation in BMI-for-age z-score, on average, due to an extra sibling, whereas children between the ages of 1–4 experience a loss of 0.50 of a standard deviation in weight-for-age z-score due to an extra sibling. The empirical findings reveal that the negative impact of having a large family size on completed years of schooling and ERT are relevant to the urban settlement and the nuclear family setting. These negative impacts on the average schooling outcomes primarily emerge from families that have five or more children. The impacts on health outcomes are relevant to the rural settlement and to both the extended and the nuclear family settings.

The rest of the paper is organised as follows. Section 2.2 provides a contextual background and discusses the related studies in the literature that have motivated this study. I then expand on the studies relevant to the Indian context and underscore the relevant contribution to the existing gap in the literature. Section 2.3 presents the theoretical model of Becker and Lewis (1973). Section 2.4 presents the data and the descriptive statistics of the sample under study. Section 2.5 discusses the empirical strategy and identification. Section 2.6 presents the main results. Section 2.7 discusses the key findings, caveats of the study and concludes with policy implications and avenues for future research.

2.2. Contextual background

In the subsection below, I revisit the Q-Q trade-off literature and provide a broad overview of the studies that have been done so far in both developed and developing countries. In the following subsections, I narrow the research focus to India, identity the existing gaps in the literature and subsequently outline my contributions.

2.2.1. Literature review

The association between child-quantity and child-quality has been extensively researched since the 1960s in the context of developed as well as developing countries, where notable contributions reveal positive, negative and null effects. The contributions by Anh et al. (1998), Blake (1981), Knodel et al. (1990), Knodel and Jones (1996), Knodel and Wongsith (1991), Psacharopoulos and Arriagada (1989) reveal a negative association between child-quantity and child-quality. In contrast, Chernichovsky (1985); Gomes (1984), Mueller (1984) find positive associations. However, Arnold (1976), Clark (1979), Shavit and Pierce (1991), Sudha (1997) do not find any association.

In the context of Brazil, Psacharopoulos and Arriagada (1989) use grade attainment by children between 7–14 years. Grade attainment is a truncated dependent variable as it is not known how much schooling these children would have attained if they have been enrolled in school. Using an ordinary least squares (OLS) procedure as well as a tobit model, they find a negative association between the number of school-aged children and their grade attainments. Similarly, Anh et al. (1998), in the context of Vietnam, use four measures of educational attainment: ever attended school, finished primary school, entered lower secondary school and finished upper secondary school. They find a negative association only for families with six or more children. They have used logistic regressions and interpreted the negative association between family size and child's school attendance in terms of log odds ratio. They find that controlling for additional explanatory variables, such as region, parental education and household wealth, considerably reduces the strength of the association between family size and current school attendance for all age groups: 10-12; 13-18; 19-24. In addition, they find there is no significant advantage for boys, except at secondary schooling. This result is consistent with the study by Knodel and Jones (1996) in the context of Vietnam, where boys take longer than girls to complete any particular level of schooling although, on average, boys start schooling earlier than girls. Knodel et al. (1990) study the quantity-quality trade-off in the context of Indonesia. Educational attainment is measured by the proportion of children who have entered or are likely to enter lower secondary school and the proportion of children who have entered or are likely to enter upper secondary school. Using a logistic regression technique, they find that children from smaller families are more likely to continue education to higher levels (i.e., lower secondary school and upper secondary school), on average, than children from larger families. In contrast, Shavit and Pierce (1991) find a null effect in the association between the number of siblings and educational attainment for three ethnic groups in Israel, Ashkenazi Jews, Oriental Jews and Muslim Arabs, by using an OLS procedure and a logit model. The educational attainment is measured by years of education, completed primary education, entered secondary education, completed secondary education, entered post-secondary education. Desai (1995) finds negative association between family size and height-for-age z-score using cross-section of countries from Demograph and Health Survey dataset of 1986-90.

Recent studies have used several identification strategies for child-quantity to strengthen the causal analysis. For example, Black et al. (2005) have used the n^{th} *delivery of twins* to instrument family size using an administrative data of Norway comprising of population between the ages of 16–74 during 1986–2000. Their study finds that the child-quantity and child-quality trade-off is sensitive to birth orders of children, i.e., the results become negligible by controlling for birth order of children; the instrumental variable (IV) estimates are considerably smaller than OLS estimates.

Gender composition as an instrument for family size has been used by Black et al. (2005), Conley and Glauber (2006), Goux and Maurin (2005), Lee (2008). By using the *same gender of first two children* as an alternative instrument for family size, Black et al. (2005) find that an increase in family size significantly leads to higher educational attainments for children. Therefore, their findings reveal that the two instruments for child-quantity have a contrasting impact on children's educational outcome. In addition, they do not find the magnitude of this estimate credible and suspect the exogeneity of this instrument. Following Black et al.

(2005), Angrist et al. (2005) have exploited two instruments, namely n^{th} *delivery of twins* and *mixed sibling gender composition* as exogenous variations for family size. In Israel, there are large differences in family size among ethnic groups: for example, Jews of African and Asian origin are different from Jews of European and North American origin. Therefore, they have thoroughly taken care of these differences through interaction dummies of multiple births with ethnic groups. They find OLS estimates are strongly negative, while IV estimates generate no evidence of negative consequences of increase in sibling-size on the educational outcomes, namely years of schooling, highest grade completed and college graduation.

Twins as an instrument is also used by Caceres-Delpiano (2006), Qian (2006) and Li et al. (2008). Caceres-Delpiano (2006) uses *twins* and finds negative impact of child-quantity on private school enrolment, using US Census data. Qian (2006) exploits an exogenous variation in family size caused by implementation of the 'One Child Policy' in China to examine a causal effect of family size on children's school enrolment. Qian also uses *twins* and finds that having one sibling has a positive effect on child's schooling, while an increase from one to two siblings has a negative effect. In the context of China, Li et al. (2008) use n^{th} *delivery of twin births* to examine its impact on children's educational attainment level and school enrolment; they find negative impact of *twin births at first and third deliveries* on children's educational outcomes. These results are robust to children's birth order control. The trade-off is predominantly observed for the rural children.

Maralani (2008) uses a different instrument (i.e., *number of miscarriages* experienced by a woman) to control for the endogeneity of child-quantity in the context of Indonesia. She considers a sample of Indonesian children between the ages of 6–19. The number of miscarriages that a woman experiences is a constraint to fertility.[5] However, miscarriage experienced by a woman is endogenous because a woman's miscarriage is correlated with her preference to have more children. For example, mothers who desire to have more children are likely to ex-

[5]The reason for not using *twins* in her study is because twinning is a rare event and is limited by data. On the other hand, information on the number of miscarriages is readily available from most of the survey data.

perience many pregnancies and, therefore, experience more chances of miscarriages because of an increase in exposure to the risk of miscarriage (Kline et al., 1989). Another problem with using miscarriage information is a recall error. In addition, a woman's knowledge regarding a miscarriage may vary with her age, level of schooling and place of residence (i.e., whether she is residing in urban or rural area). Given that a woman's fertility or a miscarriage can be influenced by her knowledge and her contraceptive use, it cannot be a valid instrument for fertility. Therefore, Maralani acknowledges this weakness of the instrument and uses a slightly different approach to address an identification. She regresses the number of miscarriages experienced by Indonesian women on their total number of pregnancies and on pregnancies squared and pregnancies cubed using a Poisson model. Assuming that the residual from this regression is orthogonal to the number of pregnancies, this residual together with residual squared and residual cubed are used as the instruments for family size. Using these instruments, Maralani finds that in urban sub-sample, family size has a positive impact on schooling outcomes (namely, years of school completed, completed junior secondary school, entered senior secondary school) for older cohorts (1948–57; 1958–67) but a negative impact for more recent cohorts (1968–77). In rural sub-sample, there is a little evidence of statistically significant association between family size and children's schooling outcomes.

Further relevant contributions to a causal analysis in this field of research (such as Becker et al. (2010), Bougma et al. (2015), Dang and Rogers (2013), Hotz et al. (1997)) are summarised in Appendix Table A2.1.

The empirical findings in the literature are mixed because of diverse social, economic and cultural factors across countries. For example, Caldwell et al. (1985) discuss how education cost in sub-Saharan Africa is spread among a wide circle of a couple's relatives. In such a scenario, the number of children that a couple possess may hardly affect the educational attainments of those children. Similarly, in West Africa, child fosterage serves as a way by which parents with a large family can obtain economic support and education for their children (King, 1987). Mueller (1984) also explains that in a developing country context, such a trade-off may not exist if the costs of schooling do not fall on children's parents. This is more so in the rural areas of developing countries where schooling is made free by government at least at the primary level.

2.2.2. Indian context

In the context of India, the use of *twin ratio* to address an endogeneity in child-quantity has been first pioneered by Rosenzweig and Wolpin (1980a). *Twin ratio* is defined by the number of twin births divided by the number of pregnancies per woman. Rosenzweig and Wolpin (1980a) have used a household level sample that comprises of 1,633 children (between the ages of 5–14), of which 25 were twins. They have used three rounds of data collected between 1969 and 1971 by the National Council of Applied Economic Research in New Delhi, India. Their study finds a negative effect of family size on child quality measured by an age-standardised index for schooling attainments. The age-standardised index is defined by ratio of schooling attainment of child i at age x to the schooling attainment of all children of age x in the total sample. These indices are constructed for all twin- and non-twin-children. The trade-off is higher for the sample including twin children.

Although the denominator of *twin ratio* is endogenous, which may question the validity of the instrument, such a natural experiment with twinning has been first conducted by Rosenzweig and Wolpin (1980a). Since then, *twins* have been extensively used in the literature to examine a causal impact of child-quantity on child-quality in many developed countries (Black et al., 2005, 2010; Angrist et al., 2005, 2010; Caceres-Delpiano, 2006; Li et al., 2008; Dayioglu et al., 2009; Sanhueza, 2009; Ponczek and Souza, 2012; Fitzsimons and Malde, 2014).

Clark (2000) finds empirical evidence from India that son preference affects gender-composition of children in a family; smaller families have a significantly higher proportion of sons than larger families. Therefore, a first-born girl is likely to increase a family size due to son preference. Therefore, in a recent study in India, Kumar and Kugler (2017) (like Lee (2008)) have used *first-born girl* to address the endogeneity of child-quantity using the 2007-08 District Level Health Surveys (DLHS) and the first round of the NFHS (1992–1993). The sample comprises of children between the ages of 6–20. The educational outcomes are measured by two indicators, namely years of education and primary school completion. They find that having a large family negatively affects children's educational outcomes. They find this trade-off to hold across all caste groups, for all levels of mothers' education, in both rural and urban areas, and for children belonging to families possessing low or medium wealth.

With respect to health of children, in a recent study, Azam and Saing (2018) have used height-for-age as child-quality measure for the 6–18 year old IHDS-II children but they have not found any trade-off using *first girl* as an instrument for family size following Kumar and Kugler (2017). In one unpublished chapter of the dissertation thesis, Sarin (2004) uses height-for-age z-score, height-to-weight ratio and immunisation (chance of receiving Measles vaccine) for below five year old children but he did not find any impact of family size on these health indicators using combined instruments for family size, such as twins and first-born son; twins and gender-composition. The use of gender-composition of children to study the impact of children on health is questionable because Pande (2003b) finds children born after multiple same-gender siblings experience poor health outcomes. This implies that same-gender siblings are likely to have a direct impact on health of children.

Further studies in India relate to gender discrimination within large size families. Makino (2018) finds no negative effect of sibling gender composition and birth order on primary school-aged girls' test scores and school-enrolment, suggesting that there is no evidence of gender discrimination (i.e., against Indian girls). However, the gender difference is visible when family size is large (with at least four or five children) and it could be possible that large size families have higher proportion of girl children, which is due to son preference in India. Similarly, Zimmermann (2012) finds intra-household discrimination in schooling expenditure against girls and Asfaw et al. (2010) find similar kind of gender discrimination in health-care expenditures.

Despite these novel contributions, there are still some gaps in the literature where I contribute some key features.

2.2.3. Contribution

I primarily contribute in the following three areas:

First, unlike the earlier studies, I have consistently used all three child-health outcomes for both the age groups of children (1–4 and 5–18), namely z-scores for weight-for-age, height-for-age and BMI-for-age, in addition to the traditionally used schooling outcomes (year of schooling and age-standardised schooling index) to measure child-quality. Furthermore, I use three new measures of schooling outcomes, namely school attendance (instead of enrolment), delay in school and ratio of actual years of schooling to expected years of schooling at a given age.

Second, for a causal analysis, Kumar and Kugler (2017) have used *first-born girl* as an instrument for child-quantity. A first-born girl child may have a direct impact on siblings' schooling attainments because an older sister in a family often takes care of the educational responsibility of her younger siblings. An empirical test supports this prediction; having a first-born girl is positively correlated with the average years of schooling completion of all siblings, which weakens the validity of the instrument for the given sample in my study.[6] In addition, *twin ratio* that has been used by Rosenzweig and Wolpin (1980b) is also endogenous by its definition. I therefore use *twin births* as an exogenous instrument and *same gender composition* as an alternative instrument for robustness analysis.[7]

[6]To test this, I use the IHDS-II dataset and regress completed years of schooling on first-born girl child together with a set of control variables, such as age of child, age of mother, squared age of mother, education of mother, Brahmin (General), General Forward Class (FC), SC, ST and OBC, FC-Muslim and Others (Christians, Sikh, Jain), age gap between the first and last child, dummy variable for birth order of children, distance to medical treatment location and state dummies. I find that the coefficient of *first-born girl* is 0.13 and statistically significant at the 1% level.

[7]I find similar negative sibling impact on educational outcomes in contrast to the findings by Black et al. (2005). Same-gender composition has been used for education outcomes and not for health outcomes as it may have direct impact on health (Pande, 2003b).

Third, a family that experiences twin births at the first delivery may have different characteristics which may influence children's outcomes differently compared to a family that experiences twin births in the latter deliveries. To examine how this kind of heterogeneity across families may influence children's schooling outcomes, I study the impact of n^{th} delivery of twins on schooling outcomes of all previous born children, following Black et al. (2005).

Fourth, I study the impact of siblings on schooling and health outcomes based on a dichotomy between an extended family and a nuclear family setting.

Finally, I have tried to address the concern relating to a closer (i.e., zero) birth spacing between children that affects educational outcomes of all previous born siblings. To do this, I have controlled for age gap between the first- and last-born children. When the gap is high, the first-born child is likely to take care of his/her younger siblings' education. Controlling for the gap is likely to mitigate a potential negative impact of zero birth spacing of twins on previous born siblings' education in a family. Similarly, contraceptive use by either of the parents is used as an alternative control variable to examine the robustness of the results.

2.3. Theoretical model

In this section, I briefly discuss the theoretical model of Q-Q trade-off formulated by Becker and Lewis (1973). Theoretical explanation behind the trade-off is that a resource-constrained household with a small (a large) family size will have enough (not enough) resource to invest in children's human capital. In other words, when the number of children increases, the marginal cost of investment in each child's quality, such as in education and health, increases in a resource-constrained household. This increase in marginal cost of investment in each child's quality makes children more expensive to parents. This will discourage parents from investing in quality due to the rise in the quantity of children. This rise in the marginal cost of child-quality due to the increase in the number of children can be demonstrated using the following theoretical framework.

Suppose, a utility function of a family is given by:

$$U = U(n, q, y). \tag{2.1}$$

where n is the number of children born in a family, q is quality of each child, y is consumption of all other commodities. The model assumes quality is same for all children in a family.

The budget constraint of a family comprises the expenditure on children as well as the expenditure on the commodity basket y. This is given by the following equation:

$$I = nq\pi + y\pi_y, \tag{2.2}$$

where I is income of the family, π is the shadow price of children with a given level of quality (nq) and π_y is the price of the commodity basket y.

The utility function in Equation 2.1 is maximised subject to the budget constraint in Equation 2.2. The Lagrangian function ($\mathcal{L}$) for unconstrained optimisation can be defined by the following expression:

$$\mathcal{L} = U(n, q, y) + \lambda(I - nq\pi - y\pi_y), \tag{2.3}$$

where λ is the marginal utility of money income. Lagrangian function is maximised with respect to the three choice variables: n, q and λ. The first order conditions for unconstrained maximum of $\mathcal{L}$ with respect to n and q are given as follows:

$$\frac{\partial \mathcal{L}}{\partial n} = 0 \implies U_n - \lambda q\pi = 0. \tag{2.4}$$

or,

$$MU_n = MC_n, \tag{2.5}$$

where is U_n = MU_n is marginal utility of n. $\lambda q\pi$ = MC_n is marginal cost of n, which is a positive function of q. In Equations 2.4 and 2.5, at equilibrium, when q increases, MC_n is higher than MU_n. This implies, when parents invest more in a child's quality, the cost of an additional child increases more than marginal utility from it with a given budget constraint. This discourages parents from having more children. Similarly,

$$\frac{\partial \mathcal{L}}{\partial q} = 0 \implies U_q - \lambda n\pi = 0. \tag{2.6}$$

or,

$$MU_q = MC_q, \tag{2.7}$$

where marginal utility of q is $MU_q = U_q$. Marginal cost of q is $MC_q = \lambda n\pi$, which is a positive function of n. In Equations 2.6 and 2.7, at equilibrium, when n increases MC_q is higher than MU_q. This implies that, when the number of children increases, the cost of investment in an additional child's quality increases more than the marginal utility from having the child, given the family budget constraint. This discourages parents from investing in child-quality. Therefore, Equations 2.5 and 2.7 explain the trade-off between child quantity and quality.[8]

2.4. Data and descriptive statistics

The 2011 India Human Development Survey (IHDS-II) dataset has been used in this study. This is a nationally representative dataset and covers all 28 states and 5 union territories of India, excluding 2 union territories, namely Andaman and Nicobar Islands and Lakshadweep.

The primary reason for selecting this dataset over the National Family Health Survey (NFHS) and National Sample Survey (NSS), is that IHDS has information on the health of children for all ages, whereas, NFHS has information on education and health of children who are

[8]A comparative static effect of an exogenous increase in child-quantity, instrumented by twin ratio, on child quality is theoretically derived by Rosenzweig and Wolpin (1980b).

below the age of 5.[9] NSS has not collected information on the health of children. In addition, IHDS-II has comprehensive information relating to households' socio-economic conditions, including – educational status, employment, income, consumption expenditure and social capital.[10]

IHDS-II dataset contains 42,152 households of which 27,579 are in rural areas and 14,573 are in urban areas. IHDS-II has interviewed all *eligible* married women between the ages of 15–49, as well as older women who were *eligible* in 2005. The information that has been collected relates to health, education, fertility planning, gender relations in the household and community. Among 39,523 women, 34,927 have completed the interview. The survey contains the birth history of 111,193 children born to the women, including those children who are either not alive or are living outside the households. The sample under study comprises of 43,731 children between the ages of 5–18 who are residing with 21,918 women (see Appendix A2.2 for further information on the sample).

2.4.1. Dependent variables

In this section, I discuss the schooling and health indicators that have been used to measure child-quality.

Schooling indicators:

First, I use completed years of schooling (denoted by Edu. Yrs.), following Angrist et al. (2005), Black et al. (2005), Hermalin et al. (1982), Knodel et al. (1990), Maralani (2008), Psacharopoulos and Arriagada (1989), Qian (2006), Shavit and Pierce (1991) and Sudha (1997).

[9]Weight-for-age z-scores based on WHO growth standard are available for children until the age of 10 years. Some states in India have many missing observations on health indicators. These states are namely Karnataka, Maharashtra, Uttar Pradesh, Andhra Pradesh.

[10]Although IHDS contains two years of panel data, a panel data analysis may not be relevant for the type of research question investigated in this study. This is because the number of children will increase overtime which may complicate a causal analysis.

Second, school enrolment does not necessarily mean children are attending school, although it has been used by Anh et al. (1998), Knodel et al. (1990), Li et al. (2008), Psacharopoulos and Arriagada (1989). Therefore, this study uses school attendance instead of school enrolment. School attendance (denoted by Attend) is a dummy variable and is assigned a value of 1 if children are absent for less than 15 days, provided they are enrolled in school; otherwise it is assigned a value of 0.

Third, delay in years of schooling (denoted by Delay) is a dummy variable and is assigned a value of *one* if a child is two or more years below the standard level of schooling (i.e., where a child is supposed be) at any given age, provided the child is currently enrolled in school; otherwise it is assigned a value of *zero*.

Fourth, ratio of actual years of schooling to expected years of schooling for a given age (denoted by ERT).

Fifth, Age-standardised schooling index defined by completed years of schooling relative to average years of schooling of children for a given age (denoted by EDT), following Rosenzweig and Wolpin (1980b).

Sixth, I use scores on reading, writing and arithmetic tests following Hanushek (1992). These test scores are available in IHDS-II for children between the ages of 8–11. The reading scores are numbered *zero* to *four*. The reading score of *zero* means cannot read; *one* corresponds to the ability to read letters; two corresponds to the ability to read words; *three* corresponds to the ability to read paragraph; *four* corresponds to the ability to read stories. The arithmetic scores are numbered *zero* to *three*. An arithmetic score of *zero* means cannot recognise numbers; *one* corresponds to the ability to recognise numbers; *two* corresponds to the ability to do subtraction; *three* corresponds to the ability to do division. The writing scores are numbered *zero* to *two*. A *zero* means cannot write; *one* corresponds to the ability to write with one or two mistakes; *two* corresponds to the ability to write without any mistakes. These tests are developed in collaboration with researchers from Pratham, India and have been pretested to ensure comparability across languages. I have redefined these discrete variables as dummy variables; for example, reading is assigned a value of *one* if reading scores are numbered from *one* to *four*, *zero* otherwise. Arithmetic scores are assigned a value of *one* if arithmetic scores are numbered from *one* to *three*, *zero* otherwise. Writing scores are assigned a value of *one* if writing scores are numbered from *one* to *two*, *zero* otherwise.

Health indicators:

The health indicators are constructed based on World Health Organization (WHO) growth standards and these include (1) weight-for-age z-score, (2) height-for-age z-score (3) BMI-for-age z-score.[11] The weight-for-age z-cores are available for children until the age of 10 years.

The growth chart consists of z-score to identify whether a child has normal growth or has a growth problem or trends suggesting a child is at a risk of a problem.[12,13] The zero line on the chart represents the median, which is the average. The other curves are z-score lines, which indicates distance from average. There are three positive z-score lines above the zero line (1, 2, 3) and three negative z-score lines below the zero line (-1, -2, -3). The growth indicators are plotted on the respective growth charts; if a plotted point lies above z-score 3 or below z-score -3 then that may indicate a growth problem or a severe health condition.

A child suffer from being underweight if a weight-for-age z-score is more than 2 standard deviation below the median (or zero line), and a child is severely underweight if a weight-for-age z-score is more than 3 standard deviation below the median (or zero line). A child is stunted if the length/height-for-age z-score is more than 2 standard deviation below the median (or zero line), and a child is severely stunted if the length/height-for-age z-score is

[11] Note that for children below the age of five, BMI-for-age is precisely the weight-for-height/length. For children below the age of 24 months, length is measured in the lying position. Whereas, for children of 24 months or above, height is measured in the standing position. However, this study uses a common terminology i.e., 'BMI-for-age' for both the age groups.

[12] The growth chart differs by gender of child as boys and girls grow to different sizes.

[13] See Appendix A2.6 for calculation of a z-score for a growth indicator.

more than 3 standard deviation below the median (or zero line). Similarly, a child is wasted if a weight-for-length/height z-score is more than 2 standard deviation below the median (or zero line) and severely wasted if a weight-for-length/height z-score is more than 3 standard deviation below the median (or zero line).

2.4.2. Explanatory variables

Child-quantity is measured by number of surviving children residing with their mothers. The child specific characteristics that are used in this analysis include age of child, gender of child and the interaction of child's age with child's gender to capture gender differences that cumulate over time.

The mother and household specific characteristics include age of mother, squared age of mother, education of mother, distance to medical treatment location, religious and administrative caste groups and state fixed effects. The health and fertility of women are influenced by access to health facilities. Therefore, distance to medical treatment location is a crucial control variable in this analysis. Medical treatment location has four categories depending on distance from village or town. This variable is coded as: *one* if location is from the same village or town; *two* if location is from another village; *three* if location is from other town and *four* if location is from a town in a different district.

Several religious and administrative caste groups (or communities) include Brahmin General, Forward Class General (FC), Forward Class Muslims (Muslims), disadvantaged class (includes Other Backward Class (OBC), Scheduled Caste (SC also called 'Dalit') and Scheduled Tribe (ST also called 'Adivasi')), and 'Others' (includes Christian, Sikh and Jain). Majority of the population in India are identified as Hindu. The collective proportion of population who are identified as Christian, Sikh and Jain are relatively small in number (i.e., approximately 2% in the IHDS-II dataset) and are therefore grouped under the 'Other' category, which is considered as the base category in all the regression models.

2.4.3. Sample descriptive statistics

Child level characteristics:

Table 2.1 below compares the descriptive statistics of children residing with their mothers who have at least a pair of twin children and mother who do not have twin children. The total number of children in the sample under study is 43,731 out of which 42,903 children have non-twin siblings and 828 children have twin siblings. The average age of children is 11.8. There is no statistically significant difference in the average age of children between the two types of family. The proportion of boys in non-twin families is larger than in twin families. School attendance among children in non-twin families is higher than among those born in twin families. The children between the ages of 5–18 have completed five years of schooling on average. There is no statistically significant difference in the years of schooling among children between the two types of family. The majority of children have their reading, writing and arithmetic skills and there is no statistically significant difference in the attainment of these skills between the two types of family.

Table 2.1: Descriptive statistics for the IHDS-II children

Child characteristics:	Overall		Mother Have twins (1)			Mother Have non-twin (2)			Mean Diff. (1)-(2)
	Mean	SD	Obs.	Mean	SD	Obs.	Mean	SD	p-value
Age of child (in Years)	11.78	3.94	828	11.92	3.92	42,903	11.77	3.94	0.29
Boy Proportion (0/1)	0.52	0.50	828	0.49	0.50	42,903	0.52	0.50	0.06
Child education (5-18 years):									
Years of schooling	4.93	3.59	828	4.90	3.49	42,903	4.93	3.59	0.80
School Attendance	0.78	0.42	828	0.73	0.44	42,903	0.78	0.42	0.00
Delay in years of schooling	0.28	0.45	828	0.27	0.44	42,903	0.28	0.45	0.50
Expected to actual years of schooling (ERT)	0.59	0.31	828	0.58	0.31	42,903	0.59	0.31	0.80
Age-standardised schooling index (EDT)	1.00	0.74	828	0.99	0.76	42,903	1.00	0.74	0.80
Child test scores (8-11 years):									
Reading	0.89	0.31	168	0.90	0.30	8,835	0.89	0.31	0.70
Maths	0.85	0.36	168	0.82	0.38	8,835	0.85	0.36	0.42
Write	0.75	0.43	168	0.74	0.44	8,835	0.75	0.43	0.78

Source: Estimated are based on author's own calculation using the IHDS-II dataset.

Household level characteristics:

Table 2.2 below provides mother and the household level characteristics of the children who are between the ages of 5–18. The average age of mothers is 36 years. The average age of the mothers with twin children is higher than the mothers with non-twin children by approximately a year. On average, a woman have 4 children. These children were born in the the 1990s when the fertility rate per woman was 3.8 (refer to Appendix Table A2.3). It is reasonable to have an extra child in a twin family compared to a non-twin family which is clearly evident in Table 2.2. The average number of children born per mother in the twin family is 4.7 while it is 3.5 in the non-twin family. The difference in the number of children between the two types of family is approximately one and it is statistically significant. The average household size is larger by approximately a member in the twin sample.

There are 70% of women who are residing in the rural settlement and 64% of them belong to disadvantaged households. Hence, the average annual per capital income and average annual per capita consumption per household are very low (i.e., 20,561 INR and 21,226 INR respectively). Twin families are poorer in terms of annual per capita income and annual per capita consumption than non-twin families.

Table 2.2: Descriptive statistics for the IHDS-II mothers and the households

	Overall		Mother Have twins (1)			Mother Have non-twin (2)			Mean Diff. (1)-(2)
Mother characteristics	Mean	SD	Obs.	Mean	SD.	Obs.	Mean	SD	p-value
Age of mother (in years)	36.39	6.56	828	37.78	6.66	42,903	36.37	6.56	0.00
Education (in years)	4.23	4.65	828	4.04	4.41	42,903	4.23	4.66	0.21
No. of living children	3.50	1.65	828	4.72	1.98	42,903	3.47	1.63	0.00
From urban area	0.31	0.46	828	0.30	0.46	42,903	0.31	0.46	0.42
Household characteristics:									
Household size [1]	6.13	2.41	828	7.05	2.49	42,903	6.11	2.41	0.00
Medical treatment location[2]	1.69	0.94	828	1.68	0.92	42,903	1.69	0.94	0.75
Household assets [3]	14.81	6.39	828	14.86	6.10	42,890	14.80	6.40	0.78
Income per capita (in INR)[†]	20,561	36252	828	17,617	24,674	42,903	20,618	36,437	0.00
Consumption per capita (in INR)[†]	21,226	20,843	828	18,229	11,503	42,895	21,284	20,978	0.00
Religious/social groups:									
Brahmin (0/1)	0.04	0.20	828	0.04	0.20	42,903	0.04	0.20	0.83
FC (0/1)	0.14	0.34	828	0.11	0.31	42,903	0.14	0.34	0.01
Disadv. group (0/1)[4]	0.64	0.47	828	0.60	0.49	42,903	0.64	0.48	0.01
Muslim (0/1)	0.16	0.36	828	0.23	0.42	42,903	0.15	0.36	0.00
Others (0/1)[5]	0.02	0.14	828	0.02	0.15	42,903	0.02	0.14	0.72

Notes: [1]Household size refers to number of members in a household. [2]Medical treatment location has four categories depending on its distance. Higher category means higher distance. [3]Household Assets contain information on number of assets that a household has. The number ranges from 0 to 33. [4]Disadvantaged group includes Other Backward Class, Dalit and Adivasi. [5]Others include – Christian, Sikh and Jain. [†]One dollar is equal to 71.04 Indian rupees as of January 19, 2020.
Source: Estimated are based on author's own calculation using the IHDS-II dataset.

The majority of households (64%) belong to disadvantage groups that include OBC, ST and ST. Disadvantaged households are economically poor and deprived of many government benefits in education (i.e., in school and higher education levels) due to the practice of social discrimination although protective affirmative action (AA) has been in place since the mid of 20th century.[14] Besides, average number of IHDS-II children in disadvantaged households (i.e., OBC, SC and ST) is higher (i.e., approximately four children on average) than non-disadvantaged households (i.e., Brahmins and FC that have approximately three children on average). This implies that the economically poor households have larger number of children than non-poor households. Therefore, the empirical question on child-quantity and child-quality trade-off remains a relevant research question in the context of India.

Descriptive statistics on health of children:

[14] AA improves the access to higher education and in government jobs for the disadvantaged households.

The average z-scores for all three health indicators are negative. A negative average z-score indicates that the average health of a child is below the zero line (i.e., median line). The average z-scores in the three health indicators for the children aged 1–4 are as follows: weight-for-age is -1.59, length/height-for-age is -1.88 and weight-for-length/height is -0.69. The average z-score in the three health indicators for the children aged 5–18 are as follows: weight-for-age is -1.51, for height-for-age is -1.54 and for BMI-for-age is -0.99.

The mean differences in the z-scores for the three health indicators between twin and non-twins families are presented in Table 2.3 below. The table shows that young children (between ages of 1–4) have lower weight-for-age on average within twin families compared to non-twins families. This is reasonable because twins have lower birth weights and it takes a considerable amount of time to regain weight as they grow up. Older children (between the ages of 5–18) have lower BMI on average within twin families compared to non-twin families.

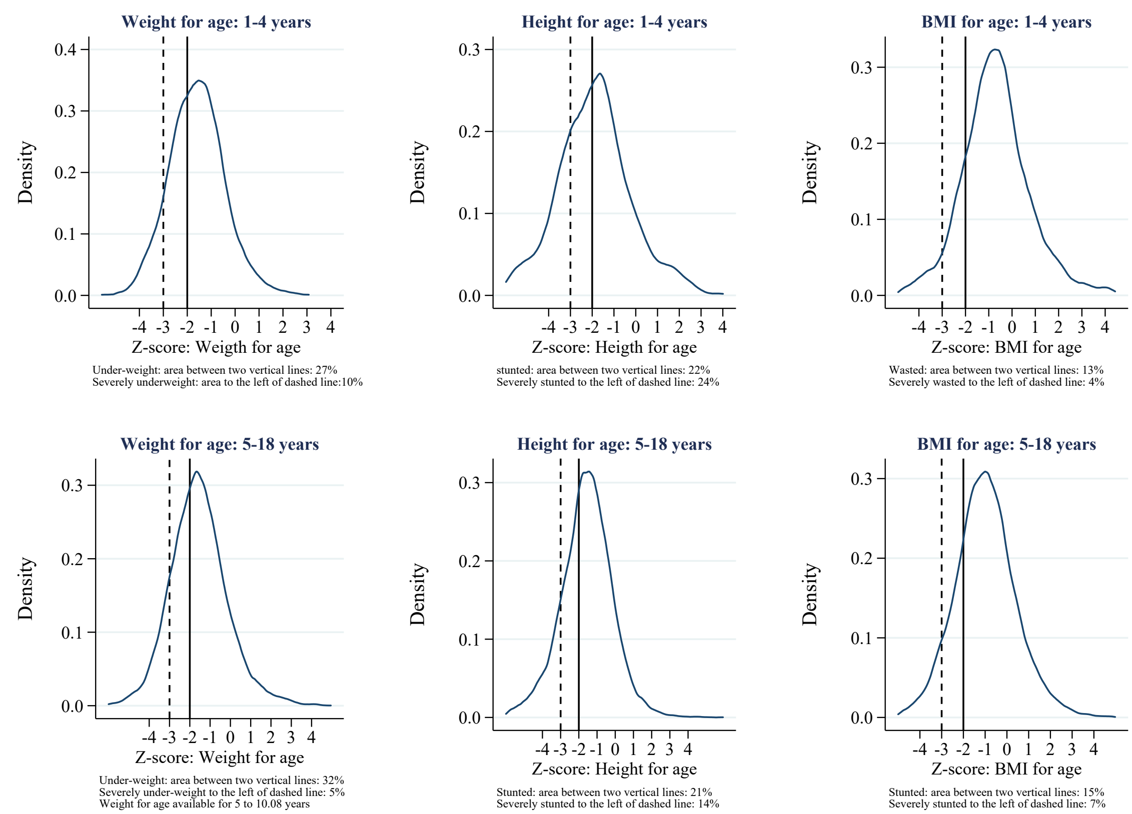
Table 2.3: Difference in z-scores between twin and non-twin mothers

Children	Z-scores	Overall Mean	Mother with twins (1) Obs.	Mean	SD	Mother with twins (2) Obs.	Mean	SD	Mean Difference (2-1)	(p-values)
1-4 years	Weight for age	-1.59	33	-1.95	1.37	2,066	-1.59	1.15	0.37	(0.07)
	Height for age	-1.88	33	-2.06	2.15	2,066	-1.88	1.66	0.18	(0.54)
	BMI for age	-0.69	33	-1.09	1.72	2,066	-0.68	1.43	0.41	(0.10)
5-18 years	Weight for age	-1.55	245	-1.63	1.45	14,091	-1.55	1.40	0.08	(0.38)
	Height for age	-1.57	623	-1.59	1.40	34,226	-1.57	1.41	0.02	(0.72)
	BMI for age	-0.98	623	-1.18	1.38	34,226	-0.98	1.40	0.20	(0.00)

Note: In the last column, the figures within parentheses are p-values.
Source: Estimated are based on author's own calculation using the IHDS-II dataset.

Figure 2.1 below provides information on the percentage of children who have z-scores more than 2 and 3 standard deviations below the median (i.e., zero line). The upper panel of the figure reveals that 27% of young children are under-weight while 10% are severely under-weight; 22% of them are stunted while 24% are severely stunted; While 13% of these children are wasted, 4% are severely wasted. Similarly, the lower panel of the graph reveals 32% of older children are under-weight while 5% of them are severely under-weight; 21% of them are stunted while 14% are severely stunted; While 15% of these children are wasted, 7% are severely wasted.

Figure 2.1: Kernel density functions of the health z-scores



Source: Estimates are based on author's own calculation using the IHDS-II dataset.

It is to be noted that the health sample is smaller than education sample. This is because there are 1%–7% of z-scores that are missing for different age samples are either because these z-scores are not within the reasonable range of WHO standard or because of missing data which is systematically observed in the states of Karnataka, Maharashtra and Uttar Pradesh for both the age groups and for all health indicators. For children aged 1–4, 0.8% of weight-for-age z-scores lie outside the WHO standard range of -6 and 5; systematic missing includes: 27% from Karnataka, 9% from Maharashtra. Similarly, 6.58% of height-for-age z-scores are outside the range of -6 and 6; systematically missing includes: 20% from Karnataka and

10% from Maharashtra. While 3.02% of BMI-for-age z-scores are outside the range of -5 and 5; systematic missing includes: 21% from Karnataka, 11% from Maharashtra. For children between ages of 5 and 18, 0.26% of weight-for-age z-scores lie outside the WHO standard range of -6 and 5. WHO only estimates the weight-for-age z-score for children until the age of 10 years. Therefore, this z-score is missing for children older than 10 years; systematically missing includes: 17% from Karnataka, 8% from Maharashtra and 6% from Andhra Pradesh. Similarly, 1.7% of height-for-age z-scores are outside the range of -6 and 6; systematically missing includes: 17% from Karnataka, 8% from Maharashtra and 10% from Andhra Pradesh. About 1.6% of BMI-for-age z-scores are outside the range of -5 and 5; systematically missing includes: 17% from Karnataka, 8% from Maharashtra and 10% from Andhra Pradesh.

These cases represent a gap in the data available for analysis but there is no way of addressing this problem.

The mean observable characteristics for the sub-sample of missing health outcomes are statistically different from the included sub-sample (see Appendix Tables A2.17 to A2.22). This difference is observed for both the 0–4 and 5–18 year old age categories. This explains a possibility of selection bias in the included sub-samples considered for this study.

Let us now look at the unconditional empirical association between family size (i.e., number of children per woman) and some of the child-quality outcomes, namely years of schooling (for school-aged children) and the z-scores for weight-for-age, height-for-age and BMI-for-age for both the age groups.

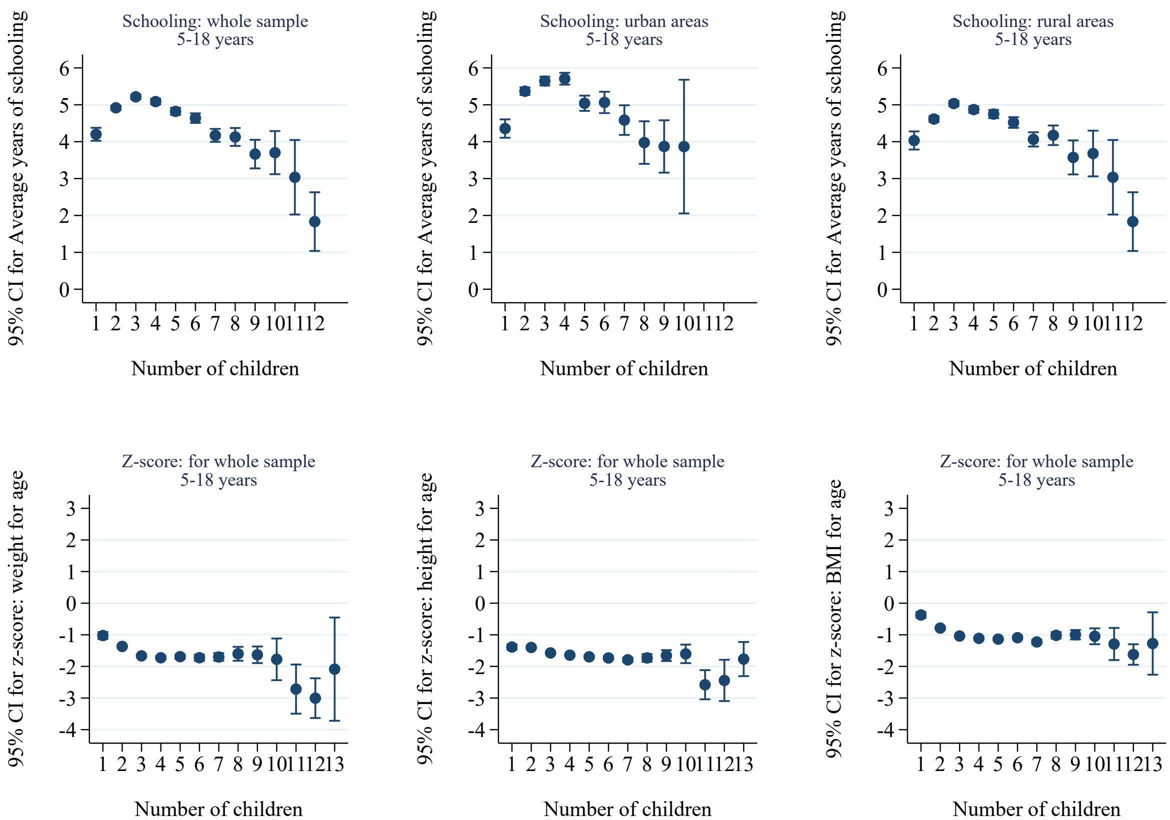
2.4.4. Empirical relationship between child-quantity and child-quality

In the sample of school-aged children (between the age of 5–18), there are 3.8% of households have one child, 27.8% have 2 children, 28% have 3 children, 17.7% have 4 children, 10.6% have 5 children, 6% have 6 children, 3% have 7 children and 1.6% have 8 children. Less than 1% of households have 9 to 13 children: 0.64% of households have 9 children, 0.28% of households have 10 children, 0.06% have 11 children, 0.04 have 12 children and remaining 0.02% have 13 children.

Figure 2.2 shows that the average completed years of schooling for school-aged children increases from roughly 4 to 5 years as the number of children per woman increase from 1 to 3 and it starts declining thereafter. As the number of children increase from 3 to 12, the completed years of schooling continuously decreases. Children with 11 siblings (i.e., a family with 12 children) end up completing approximately 2 years of schooling on average. A similar picture is observed within the rural sub-sample. Within the urban sub-sample, the average years of schooling attainment increases from 4 to 5 years (approximately) as the number of children increases from 1 to 3 and starts declining for families with 4 or more children per woman. We thus observe an inverse U-shaped association between years of schooling and the number of children in both urban and rural sub-samples. An empirical investigation of such non-linearity is investigated in Section 2.6.2.

In addition, if we compare the state-wise fertility rates and average years of schooling of children in India (see Appendix Table A2.4), the data clearly shows that there is an existence of an inverse relationship between the two variables of interest and for both 5–14 and 15–18-year-old children. Therefore, an empirically investigation of a causal impact of child-quantity on child-schooling outcomes is of a policy relevance.

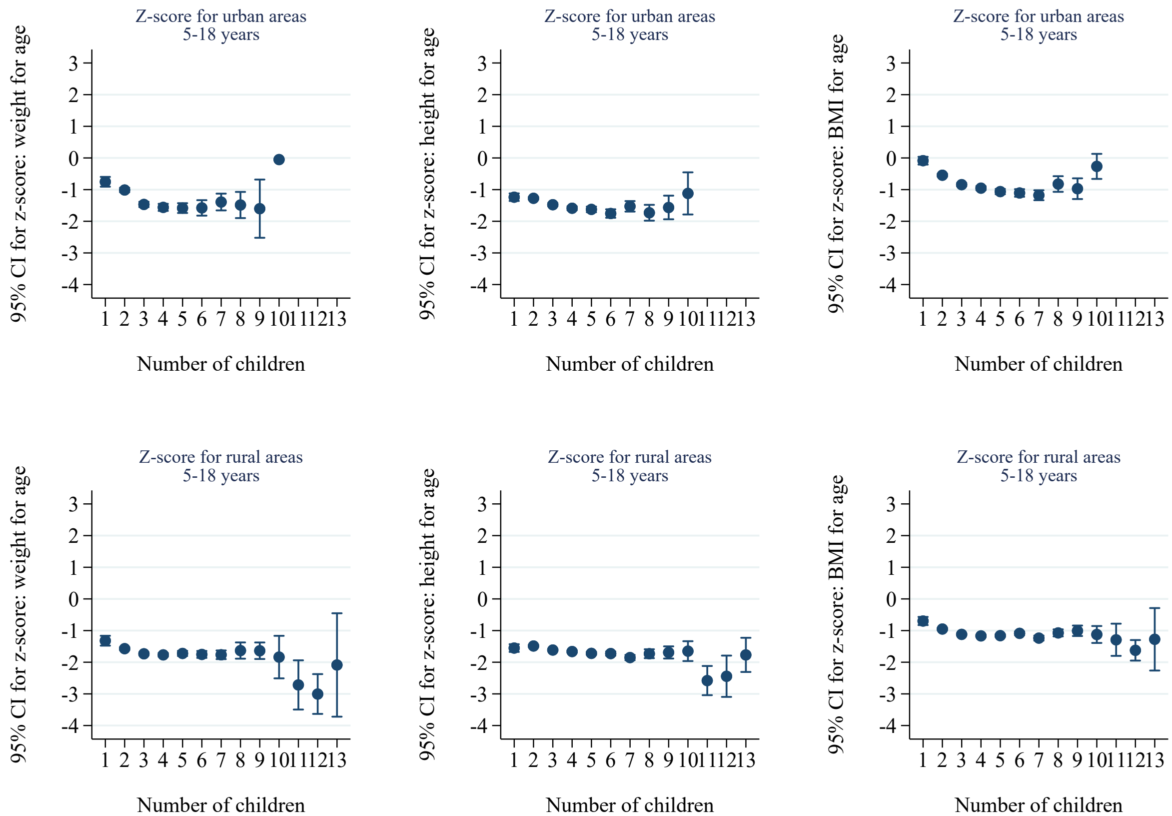
Figure 2.2: Association between child-quantity and child-quality (years of schooling and health z-scores) for 5–18-year-old children



Source: Estimates are based on author's own calculation using the IHDS-II dataset.

If we look at the z-scores for all three health indicators for all schooling-aged children, we observe that as the number of children increases from 1 to 3 the weight-for-age z-score keeps declining from -1 to -2 and it remains stable thereafter until 10 children. As the number of children increases from 10 to 12, the z-score declines below -2 and it drops to -3 for mothers with 12 children; there are only 0.04% of mothers who have 12 children. Such decline is emerging from rural areas (see Figure 2.3). In urban area, the average z-score for weight-for-age remain between -1 and -2 for mother with 3 to 9 children (see Figure 2.3).

Figure 2.3: Association between child-quantity and health z-scores for 5-18-year-old children: Urban versus rural settlement



Source: Estimates are based on author's own calculation using the IHDS-II dataset.

The graph for height-for-age z-score appears to be more or less flat hovering between -1 and -2 as the number of children increases from 1 to 10 in both rural and urban areas and it declines below -2 for mothers with 11 and 12 children in rural areas (see Figure 2.3).

BMI-for-age within urban sub-sample of school-aged children shows a U-shaped pattern. As the number of children increases from 1 to 7, the z-score keeps declining from zero to slightly below -1 and it starts to rise above -1 thereafter but remains below the zero line (see Figure 2.3). Similar declining patter in the z-score is observed within rural areas as the number of children increases from 1 to 8. As the number of children further increases from 9 to 13 in rural areas, the score starts declining further below -1 (see Figure 2.3). Hence, the overall pattern of relationship between z-score for BMI-for-age and family size in the whole sample is emerging from rural areas.

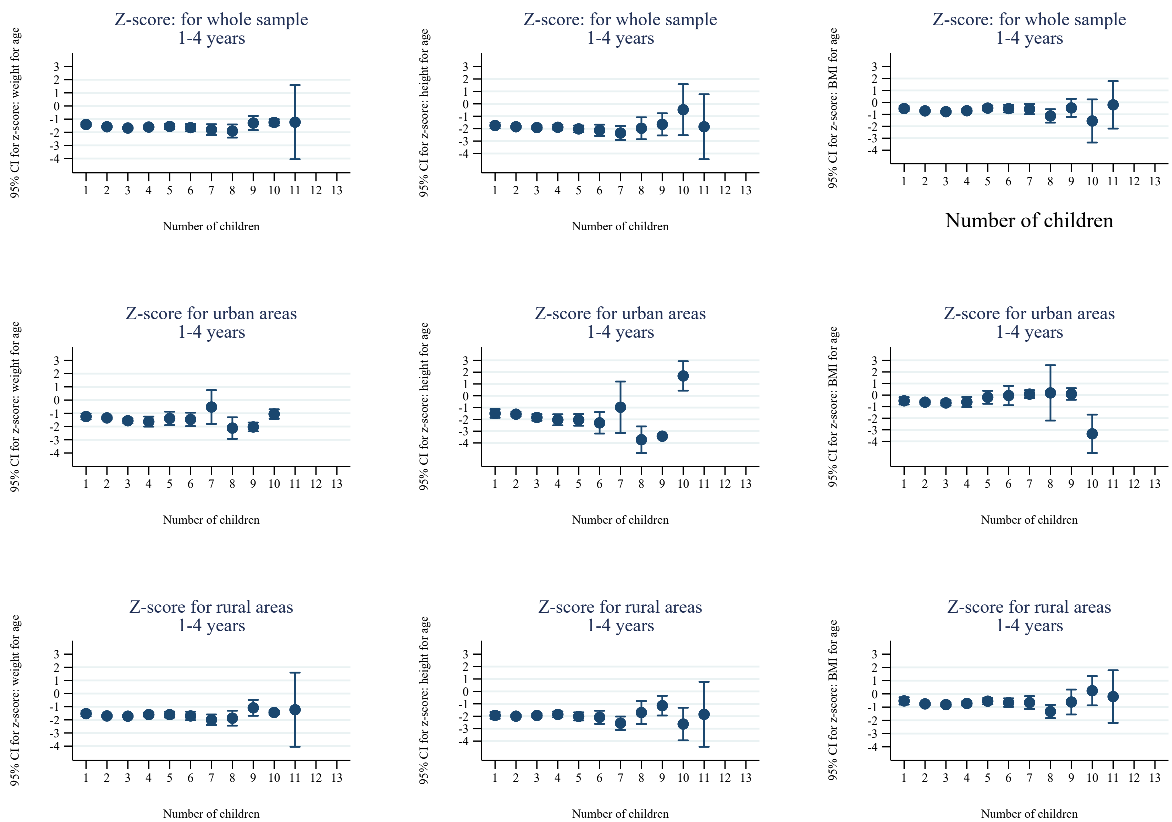
We thus observed that the decline in z-scores for the three health indicators for the sample of school-aged children are relevant to rural sub-sample.

Let us now look at the sample of young children (between the ages of 1-4). For the overall sample of young children (sample size is 2,099) the graph of weight-for-age z-score graph looks flat. As the number of 1–4 year old children increases from 1 to 3 the z-score declines slightly between -1 to -2 and it declines to -2 when the number of children increases to 8; it starts to rise thereafter but the score remains below -1. Similar picture is observed in both rural and urban sub-samples. Thus, no severe underweight issue is observed for the sample of young children.

For the overall sample of young children, the graph of height-for-age z-score remains flat and keeps hovering around -2 score until five children and it starts to decline below -2 when the number of children increases from 6 to 7; it starts to increase thereafter but remains below the zero line. This picture is similar to rural sub-sample (sample size is 1,485). In the urban sub-sample, mother who have 1 or 2 children their average z-scores lies between -1 and -2 and it starts declining to -2 when the number of children increases from 3 to 5; it declines further below -2 for 6 children. Given that the urban sample size is very small i.e., 614 and mother having 7 or more children are less than 1%, the average z-score estimated for 7 or more children may not be precise. Severe stunting issue is not observed in the overall sample and in rural sub-sample of young children.

The graph for BMI-for-age for young children more or less remains flat. As the number of children increases from 1 to 9, the z-score remains between 0 to -1. It drops below -1 for 10 children. Similar picture is observed in the rural sub-sample. In the urban sample, the z-score remains between 0 to -1 as the number of children increases from 1 to 6 and it touches the zero line for 7 to 9 children but declines sharply for 10 children below -3; this estimate may not be precise because there are only 0.49% of mothers who have 10 children in the urban sample of size 614.

Figure 2.4: Association between child-quantity and health z-scores for 1–4 year old children



Source: Estimates are based on author's own calculation using the IHDS-II dataset.

2.5. Empirical strategy and identification

I estimate the effect of fertility on schooling and health outcomes using a linear regression equation that can be written as,

$$y_{ij} = \alpha + \beta N_j + \gamma C_{ij} + \mathbf{\Theta}_0 \mathbf{X}'_j + \varepsilon_{ij}, \tag{2.8}$$

where y_{ij} denotes schooling and health outcomes for the i^{th} child of the j^{th} mother. It includes

Edu. Yrs., Attend, Delay, ERT, EDT, test scores, z-scores for health indicators, as discussed in Section 2.4.1. N_j denotes the number of children born and residing with the j^{th} mother, C_{ij} is a vector of child specific characteristics; these include age of a child, gender of a child and interaction of age and gender of a child. $\mathbf{X}_j$ is a vector of mother and household level characteristics, these include age of a mother, squared age of a mother, education of a mother, medical treatment location (this variable has four categories as discussed in Section 2.4.2), religious or social groups, state dummies, and ε_{ij} is the error term.

The outcomes variables namely Attend, Delay and test scores (in reading, arithmetic and writing) are binary variables. I therefore use a linear probability model for regression analyses using these variables. The remaining outcome variables are continuous and therefore OLS procedure is used for descriptive analyses.

2.5.1. Identification strategy

As the fertility decisions are taken by parents depending on a household's economic condition, parents' future expectations from their children, parents' knowledge in birth control techniques, social and cultural norms (such as preference for a boy in a family) and many more unobserved factors, child-quantity (i.e., N_j) is an endogenous variable in Equation 2.8. Parents' preference for an 'ideal' family size depends on the cost of investment in children's human capital. If these confounding factors are not controlled in the regression analysis, then Equation 2.8 will give a biased estimate of the β. Given that these omitted variables are difficult to measure and control in the model, establishing a causal link is challenging. To examine a causal link, I instrument child-quantity with *twins*.

Twin births practically mean an 'extra child' and it is therefore likely to increase the number of children. The empirical test for the relevance of this instrument is discussed in the results section. For an orthogonality of the instrument, it can be argued that people in India have limited access to ultra-sound technology because prenatal gender detection is still illegal in

India. Besides, culture (i.e., family conservativeness) plays a vital role in the restrictive use of such a technology since fertility is a highly sensitive issue for women in India. In addition, *in vitro* fertilisation is very expensive and not affordable for people in general. A total of 70% of the women in the sample are from rural areas and their economic condition may not allow them to have access to such a technology. Therefore, this instrument can be considered as exogenous in the Indian context. Empirical tests for an orthogonality of *twins* is presented in the results section. In the given sample, empirical tests show that *twins* do not have any direct impact on the children's education and health outcomes. These tests strengthens the validity of the instrument. In addition, I use the available information of contraceptive use by either parent as an alternative control to strengthen the orthogonality condition. This is because *twin births* may be influenced by parents' knowledge of birth prevention instruments. I therefore control for this variable and examine the robustness of the results.

In a two stage least squares method (2SLS), to study a causal impact of child-quantity on child-quality, the first stage regression equation can be written as,

$$N_j = \alpha' + \beta' Twins_j + \gamma' C_{ij} + \mathbf{\Theta}_1 \mathbf{X}'_j + \epsilon_{ij}, \tag{2.9}$$

where N_j is the number of living children born to the j^{th} mother. $Twins_j$ is a binary variable and is constructed using months and years of birth that are available from the children's birth history. All children who are born to the same mother and have the same age are considered to be twins. The twin variable is assigned a value of *one* if a mother has twins, otherwise it is assigned a value of *zero*.

Second stage of a 2SLS regression equation can be written as,

$$y_{ij} = \alpha'' + \beta'' \hat{N}_j + \gamma'' C_{ij} + \mathbf{\Theta}_2 \mathbf{X}'_j + \xi_{ij}, \tag{2.10}$$

where, vectors C_{ij} and X_j are the same as in the first stage regression equation (i.e., Equation

2.9). $\hat{N}$ is predicted values of N obtained from the first stage regression Equation 2.9.

However, using *twins* as an instrument is not free of caveats. The major practical problems with twins are as follows: *First*, twinning is a rare event. In the sample there are only 1.9% of children who are between the ages of 5–18 and are twins. *Second*, twinning may affect sibling outcomes through mechanisms other than family size, such as (i) closer birth spacing (Black et al., 2005); (ii) reallocation of family resources from twins towards non-twin children (Behrman et al., 1994; Behrman and Rosenzweig, 2004; Rosenzweig and Zhang, 2009). The concerns relating to closer birth spacing and reallocation of family resources are discussed in the following sections.

2.5.2. Birth spacing

Birth spacing may influence twin births and the outcomes in several ways. *First*, a mother is more likely to have twins if their birth is spaced farther from the previous birth, conditional on her age at the previous birth (Li et al., 2008). To examine this, I regress *twins* on age gap between previous birth and twin births using an LPM model; I find that the impact of age gap on the probability of twin births is negligible and insignificant.[15]

Second, it is well-established in literature that closer spacing between last pair of children have negative effect on educational outcome of earlier born children (Rosenzweig and Zhang, 2009). If this is true, then zero birth spacing of twins will have a negative effect on educational outcomes of earlier born children. To test this I consider a sample of non-twin children and regress completed years of schooling of X children on the age difference between the two following children, conditional on there being Y children in the family where $X = 1, 2, 3, 4$ and $Y = 3, 4, 5, 6$. The results are presented in Appendix Table A2.7 which shows, there is a positive association between the age gap of two successive younger siblings on education

[15] I find the coefficient of age gap is positive and equal to 0.02 with p-value 0.135. I have controlled for mother's education, age of mother, squared age of mother, gender, interaction of gender with child age, social classes, state dummies, medical treatment location. The result is robust when birth order of children is controlled.

outcomes of the earlier born siblings. The estimates are statistically significant at the conventional levels of 1% and 5%. This implies older children do better when younger children are spaced further apart. This result can be extrapolated on twins for whom age spacing is approximately zero. This would imply twin births can adversely affect prior children's educational outcomes, not only through an increase in family size but also through closer birth spacing between them. To control for the spacing issue I use two approaches: *first*, age gap between the first and last children is used as an additional control in regression analyses. This is because if a gap between the eldest and youngest children of a mother is very high then it is highly likely that the eldest child will assist in the younger siblings' education (including twin children) (Masako and Moffatt, 2007) which will potentially net out a negative impact of birth spacing. *Second*, I use contraceptive use by either of the parents as an alternative control variable to address this spacing concern.

2.5.3. Resource reallocation between twins and non-twins

Twin children experience lower birth weights and therefore have poorer endowment to start with compared to non-twin children. Therefore, parents are likely to invest more resources on non-twin children (with better endowment) than on twin children (with poorer endowment) (Behrman et al., 1994; Behrman and Rosenzweig, 2004; Rosenzweig and Zhang, 2009). Using a sample of Chinese twins, Rosenzweig and Zhang (2009) find some empirical evidence of a reinforcing behaviour of parents, where a reallocation of resources from twins to non-twin children has a negative effects on educational outcomes of twin children but a positive effect on educational outcomes of non-twin children. The difference between reinforcing parent and compensating parents has been discussed by Becker and Tomes (1976) and Clarke (2016). Reinforcing parents have a tendency to take away resource from poor quality children and invest more on better quality children. On the other hand, compensating parents are those who not only invest in better quality children, but also in poorer quality children to improve educational performance of all children. Therefore, reinforcing parents will reinforce the investment differences between their twin and non-twin children and transfer their resources to non-twin children (who have better health endowment). Hence, β'' in Equation 2.10 will underestimate the magnitude of trade-off, i.e., β'' is expected to be closer to zero. On the other hand, compensating parents will compensate for children with poor health endowments (i.e., twins) and will either allocate more resources to twin children or will allocate resources to all children equally. Therefore, the trade-off is expected to be larger in this case as the given family resource is shared among all children equally; this means β'' in Equation 2.10 will overestimate the magnitude of trade-off (i.e., it is expected to be even more negative). It is likely that the educated mothers are of a compensating nature compared to mothers with no education. Therefore, mothers' educational attainments are controlled in regression analyses, which may potentially capture this kind of parental nature.[16]

2.6. Results

In this section, I present the OLS and 2SLS results, using twins as instrument for the number of children to study its impact on schooling outcomes for children between the ages of 5–18. At first I use the entire sample of school-aged children to examine the average impact. I then present the results for different family sizes using n^{th} *delivery of twins* as an instrument for the number of children in order to examine the heterogeneity across mothers who have experienced twin births at different deliveries.

I further examine the heterogeneity across types of settlement (i.e., urban versus rural settlement); across gender and settlement types; and types of family setting (i.e., an extended versus a nuclear family setting). For these sub-sample studies, I consider all the children, instead of considering different family sizes because of a significant reduction in data points.

[16] The concern of resource reallocation could be controlled by considering birth weights of children. However, the IHDS-II dataset does not have information on birth weights of children to proxy for their health endowments. So, for the current purpose of the study, I control for mothers' educational attainments.

Besides, there are approximately 2% twins in the entire sample of 43,731 children. Hence, the strength of the instrument is weaker in such smaller sub-samples.

I perform robustness tests using additional control variables, such as birth order of children, age gap between the first and last children, contraceptive use by either of the parents. In addition, I have used *same gender composition of the first two children* as an alternative instrument to *twins*.

I finally present health outcomes for two different age groups of children: 1–4 year old children who are termed as young children; and 5–18 year old children who are termed as school-aged children. For these samples, I also study the heterogeneity across types of settlement and types of family setting.

2.6.1. Effect of child-quantity on the schooling outcomes

The OLS results in Table 2.4 show, on average, an additional child in a family reduces the completed years of schooling of children by 0.18 years; it reduces the probability of school attendance by 1.2 percentage points; it reduces ERT by 0.03 of a unit, and it reduces EDT by 0.03 of a unit. The probability of delay due an additional child increases by 1.1 percentage points. These results are significant at the 1% level. Using the 2007-08 District Level Household Survey (DLHS) in India, Kumar and Kugler (2017) find that the OLS estimate for the completed years of schooling is -0.12, which is similar to my finding in this study.

Table 2.4: Effect of child-quantity on the schooling outcomes

	Without birth order of children					With birth order of children				
	Edu. Yrs.	Attend[1].	Delay	ERT[2]	EDT[3]	Edu. Yrs.	Attend.	Delay	ERT	EDT
OLS (Education indicators regressed on No. of children)										
No. of children	-0.175***	-0.012***	0.011***	-0.026***	-0.026***	-0.240***	-0.019***	0.005***	-0.007***	-0.022***
	(0.008)	(0.002)	(0.002)	(0.001)	(0.002)	(0.010)	(0.002)	(0.002)	(0.001)	(0.003)
R-squared	0.768	0.083	0.117	0.218	0.075	0.770	0.086	0.118	0.239	0.075
First stage of 2SLS (No. of children regressed on twin births)†										
Twin births	1.072***	1.072***	1.072***	1.088***	1.088***	1.053***	1.053***	1.053***	1.040***	1.040***
	(0.052)	(0.052)	(0.052)	(0.052)	(0.052)	(0.045)	(0.045)	(0.045)	(0.046)	(0.046)
R-squared	0.455	0.455	0.455	0.447	0.447	0.575	0.575	0.575	0.569	0.569
No. of twins	828	828	828	828	828	828	828	828	828	828
Second stage of 2SLS (Education indicators regressed on No. of children)										
No. of children	-0.117*	-0.036***	-0.008	-0.019**	-0.007	-0.119*	-0.037***	-0.009	-0.016*	-0.005
	(0.062)	(0.014)	(0.014)	(0.009)	(0.023)	(0.063)	(0.014)	(0.014)	(0.009)	(0.024)
F-Statistic	425	425	425	431	431	543	543	543	513	513
Observations	43,731	43,731	43,731	43,731	43,731	43,731	43,731	43,731	43,731	43,731

Notes: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Standard errors are reported in parentheses.standard errors are reported in parentheses. Significance of coefficients is based on robust standard error.

[1]Attendance is a dummy variable: if children are absent for less than 15 days, attendance=1, provided they are enrolled in school. [2]ERT is completed years of schooling relative to expected years of schooling at any given age. [3]EDT is age standardised schooling index; †Number of children is instrumented with twin births. Kleibergen-Paap Wald F-statistic are reported. The regression equations control for age of child, age of mother, squared age of mother, education of mother, child gender, child gender*child age, medical treatment location and state dummies, communities include Brahmin, FC-General, disadvantaged groups (SC, ST and OBC), FC-Muslim and Others (Christians, Sikhs and Jains) are considered as base categories.

Source: Estimates are based on authors' calculations using the survey data.

Before interpreting the 2SLS results, let us first look at the empirical test for the validity of the instruments. In Table 2.4, the coefficient of *twins* appears to be positive and statistically significant at the 1% level. The Kleibergen-Paap Wald F-statistics are sufficiently larger than the rule-of-thumb of 10 for it statistical relevance.

An orthogonality of an instrument requires that, i) an instrument must not be correlated with any unobserved characteristics in the error term ξ_{ij} in Equation 2.10; in other words, $cov(twin, \xi_{ij}) = 0$; ii) an instrument can only affect outcome variables through a problematic endogenous variable (i.e., N_j), which is instrumented, but cannot directly affect outcome variables. The first condition is difficult to test. However, following Black et al. (2005), I examine whether the probability of twins is related to observed characteristics, such as mother's and father's education. To test this, I use a linear probability model and regress *twins* on mother's education as well as on father's education in two separate regression equations. The regression results indicate that the coefficients of parents' education are statistically insignificant. The results strongly suggest that twinning probabilities are not correlated to parents' education. The second condition is also satisfied for the sample under study because the instrument has no direct impact on the education and health outcomes.[17] In addition, the Pre-natal Diagnostic Technique (PNDT) Act has made foetal gender detection illegal in India (Kumar and Kugler, 2017). *In vitro* fertilisation (IVF) is a very expensive technology and cannot be afforded by general people in India.[18] Hence, *twins* as an instrument for child-quantity can be considered as orthogonal to the error process (ξ_{ij}) in the structural equation of primary policy interest (i.e., Equation 2.10).

There could be further concerns regarding twin births. It is well-established in literature that the probability of twin births increases with maternal age (Jacobsen et al., 1999; Bronars and Grogger, 1994). The probability of twin births increases when mothers are between 38–

[17]The coefficient of mother's education in the regression is -.0001 with p-value 0.442. Regression controls for other variables, such as, age of child, age of mother, age of mother square, gender, interaction of gender with child age, social classes, state dummies, age gap between first and last child, birth orders of children. Similarly, father education coefficient is .0002 with p-value is 0.229.

[18]Note that 70% women in the sample are from rural areas.

48 years due to hormonal changes with age. In the sample under study, I do not find such evidence.[19]

The 2SLS results, using twins as an instrument, are presented in Table 2.4. On average, an additional child in a family reduces the completed years of schooling of children by 0.12 years; it reduces the probability of school attendance by 3.6 percentage points; it reduces ERT by 0.02 of a unit. These estimates are statistically significant at the conventional levels and they reaffirm the existence of quantity-quality trade-off in the Indian context.

Kumar and Kugler (2017) find that the estimate for the completed years of schooling is -0.36 using gender of the first child as an instrument for the number of children. This difference in the magnitudes of the estimate is potentially due to a local average treatment effect pertaining to the chosen instruments in the two studies. By using twin births, Black et al. (2005) find that the magnitude of 2SLS estimate is smaller than the OLS estimate which is consistent with the finding in this study.

In Appendix Table A2.8, I present the results for test scores. I do not find a causal effect of children on test scores in reading, arithmatic and writing for children between the ages of 8–11.

2.6.2. Schooling outcomes: Heterogeneity by order of twin delivery

As we have seen in Figure 2.2 that the average years of schooling increases as the number of children increases from 1 to 3 and it starts declining thereafter. Hence, in this section, I investigate whether such an inverse U-shaped association holds by considering different family sizes and conditioning on all other control variables. I further examine whether such

[19] In the sample, the average age of children is 11.8 years, and the average age of mothers in the twin sample is 37 years. This means, on average, twins are born to mothers when mothers are around 26 years of age, i.e., when mothers are younger. Therefore, age of mother, on average, should not affect twin births. To test this, I regressed *twins* on mother's age together with the usual control variables used in this analysis; I find that the coefficient of mother's age is 0.001 with the corresponding p-value of 0.229. Hence, maternal age is uncorrelated with the probability of *twin births* for the sample under study.

a relationship is causal.

In addition, by considering different family size, it is possible to capture the fact that a woman who experiences twin births in the second delivery may have completely different household characteristics and is likely to experience different child outcomes compared to a woman who experiences twin births in later deliveries. In this section, I therefore examine the impact of family size of at least n children by instrumenting it with the n^{th} order of twin delivery on average schooling outcomes of all children born before the n^{th} order twin.

In Table 2.5, within families with at least two children, I examine the impact of second order twin delivery on schooling outcomes of the first born child. Although there exist negative associations between the number of children and the schooling outcomes but 2SLS results show that, on average, the first child's ERT increases by 0.07 of a unit and EDT by 0.10 of a unit if the second order births are twins (marginally significant at the 5% level).

In Table 2.5, I examine the impact of a third order twin delivery on schooling outcomes of first and second born children. In families with at least three children, a similar negative association is observed between the number of children and the schooling outcomes. However, 2SLS results show that the first two children's completed years of schooling increases by 0.57 years on average if the third order births are twins (marginally significant at the 10% level); the effects on ERT and EDT are 0.08 of a unit and 0.12 of a unit respectively (statistically significant at the 5% level).

In families with at least four children, although the negative associations persist for all educational outcomes, but there is no causal impact found for a fourth order twin delivery on schooling outcomes of all previous born children. This could be because the strength of the instrument is very weak; there are only 0.4% of twin children born in the fourth delivery.

Table 2.5: Effect of child-quantity (n^{th} delivery of twins as instrument) on the schooling outcomes of children born before twin births

	OLS					2SLS				
	Edu. Yrs.	Attend[1].	Delay	ERT[2]	EDT[3]	Edu. Yrs.	Attend.	Delay	ERT	EDT
Families with 2 or more children: Effect of **second order twin births** on first child's education										
Effect on first child	-0.312***	-0.035***	-0.005	-0.016***	-0.032***	0.352	-0.050	0.023	0.065**	0.103**
	(0.023)	(0.004)	(0.004)	(0.002)	(0.004)	(0.224)	(0.059)	(0.063)	(0.027)	(0.041)
No. of twins						62	62	62	62	62
F-Statistic						44.210	44.210	44.210	39.864	39.864
R-squared	0.717	0.160	0.110	0.238	0.126	0.681	0.159	0.107	0.144	0.055
Observations	12,037	12,037	12,037	12,037	12,037	12,037	12,037	12,037	12,037	12,037
Families with 3 or more children: Effect of **third order twin births** on first two children's education										
Effect on first two children	-0.347***	-0.038***	-0.007	-0.028***	-0.043***	0.573*	-0.029	-0.004	0.080**	0.117**
	(0.022)	(0.004)	(0.004)	(0.002)	(0.004)	(0.294)	(0.056)	(0.070)	(0.032)	(0.057)
No. of twins						67	67	67	67	67
F-Statistic						40.606	40.606	40.606	40.435	40.435
R-squared	0.617	0.177	0.085	0.215	0.153	0.530	0.177	0.085	0.023	0.014
Observations	11,668	11,668	11,668	11,668	11,668	11,668	11,668	11,668	11,668	11,668

Notes: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Standard errors are reported in parentheses.
Significance of coefficients is based on robust standard error. [1]Attendance is dummy variable: if children are absent for less than 15 days, attendance=1, provided they are enrolled in school. [2]ERT is completed years of schooling relative to expected years of schooling at any given age. [3]EDT is age standardised schooling index including twins. Regressions include age of child, age of mother, squared age of mother, education of mother, child gender, child gender*child age, state dummies, age gaps between twins and children born before twin birth, communities include Brahmin, FC-General, disadvantaged groups (SC, ST and OBC), FC-Muslim and Others (Christians, Sikhs and Jains) are considered as base categories. F-statistic is Kleibergen-Paap Wald F-statistic. Different size of family is considered to study the non-linear effect of family size on children's educational outcomes. In addition, the families that desire more children after the $n^{th}h$ twin birth may differ in characteristics depending upon whether the parents will end up with singletons or another pair of twins. To examine this possible differential effects, this table studies the effect of higher order twin births on all earlier children's education.
First stage regression results are reported in Appendix Table A2.9.
Source: Estimates are based on authors' calculations using the survey data.

Continued...

	OLS					2SLS				
	Edu. Yrs.	Attend[1].	Delay	ERT[2]	EDT[3]	Edu. Yrs.	Attend.	Delay	ERT	EDT
Families with 4 or more children: Effect of **fourth order twin births** on first three children's education										
Effect on first three children	-0.314***	-0.039***	-0.014***	-0.026***	-0.039***	-0.201	-0.080	-0.021	-0.003	-0.015
	(0.030)	(0.005)	(0.005)	(0.003)	(0.004)	(0.609)	(0.109)	(0.108)	(0.054)	(0.077)
No. of twins						27	27	27	27	27
F-Statistic						13.956	13.956	13.956	13.995	13.995
R-squared	0.512	0.187	0.062	0.185	0.158	0.511	0.177	0.062	0.176	0.154
Observations	6,795	6,795	6,795	6,795	6,795	6,795	6,795	6,795	6,795	6,795
Families with 5 or more children: Effect of **fifth order twin births** on first four children's education										
Effect on first four children	-0.259***	-0.045***	-0.017**	-0.027***	-0.038***	-1.525**	-0.035	0.236*	-0.189***	-0.282***
	(0.041)	(0.007)	(0.007)	(0.004)	(0.006)	(0.595)	(0.095)	(0.123)	(0.057)	(0.085)
No. of twins						14	14	14	14	14
F-Statistic						25.819	25.819	25.819	25.594	25.594
R-squared	0.443	0.224	0.062	0.158	0.138	0.263	0.224	-0.257	-0.237	-0.211
Observations	3,377	3,377	3,377	3,377	3,377	3,377	3,377	3,377	3,377	3,377

Notes: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Standard errors are reported in parentheses.
Significance of coefficients is based on robust standard error. [1]Attendance is dummy variable: if children are absent for less than 15 days, attendance=1, provided they are enrolled in school. [2]ERT is completed years of schooling relative to expected years of schooling at any given age. [3]EDT is age standardised schooling index including twins. Regressions include age of child, age of mother, squared age of mother, education of mother, child gender, child gender*child age, state dummies, age gaps between twins and children born before twin birth, communities include Brahmin, FC-General, disadvantaged groups (SC, ST and OBC), FC-Muslim and Others (Christians, Sikhs and Jains) are considered as base categories. F-statistic is Kleibergen-Paap Wald F statistic. Different size of family is considered to study the non-linear effect of family size on children's educational outcomes. In addition, the families that desire more children after the n^{th} twin birth may differ in characteristics depending upon whether the parents will end up with singletons or another pair of twins. To examine this possible differential effects, this table studies the effect of higher order twin births on all earlier children's education.
First stage regression results are reported in Appendix Table A2.9.
Source: Estimates are based on authors' calculations using the survey data.

In families with at least five children, again the negative association persist for all educational outcomes. 2SLS results show that the first four children's completed years of schooling reduces, on average, by 1.53 years (statistically significant at the 5% level) if the fifth order births are twins. This also increases the probability of delay in school by 24 percentage points (marginally significant at the 10% level), and its effects on ERT and EDT are -0.19 of a unit and -0.28 of a unit respectively (statistically significant at the 1% level).

First stage regression results are reported in Table 2.5. It is interesting to note that Li et al. (2008) find negative causal impact of family size induced by twin births at the first delivery and third delivery on children's educational level and school enrolment whereas I find negative impact of twins at the fifth delivery.

These findings suggest that there is no trade-off in small families (i.e., with at least two or at least three children). The trade-off becomes visible in families with at least five children. Thus the average trade-off for the overall sample of children, as evident from Table 2.4, is likely to arise from a family size of at least five children.

2.6.3. Schooling outcomes: Heterogeneity by types of settlement

The descriptive statistics on children's educational outcomes are presented in Appendix Table A2.11. The table shows children's educational performances are better in urban settlement compared to rural settlement. Average years of schooling completed by school-aged urban children is 5.34 years while it is 4.7 years for rural children. School attendance for urban children is higher than rural children by 3 percentage points; delay in the years of schooling completion at an expected age is lower among urban children than rural children by 4 percentage points; ERT is higher for urban children than rural children by 0.05 units. Among 8–11 year old children, there is statistically significant difference in reading, writing and arithmetic scores between urban and rural settlements. These scores are higher for urban children than for rural children.

The mother and household level characteristics are presented in Appendix Table A2.12. The table shows that there are statistically significant differences in these characteristics by the types of settlement. Urban mothers are older, more educated and have lesser number of children than rural women. Urban households have higher annual per capita income and annual per capita consumption than rural households. While 69% of disadvantaged groups live in rural settlement, 53% of them live in urban settlement.

OLS results in Table 2.6 shows that there is a negative association between child-quantity and child schooling outcomes in both urban and rural settlements. In urban (rural) settlement, an additional child, on average, reduces years of schooling by 0.29 (0.22) years; attendance by 2.7 (1.7) percentage points, ERT by 0.01 (0.01) of a unit and EDT by 0.03 (0.02) of a unit. These results are statistically significant at the 1% level. In addition, the chance of delay in completing an expected year of schooling at any given age is 0.4 of a percentage point among rural children (marginally significant at the 10% level). The observed negative association is reasonable because majority of these children belong to disadvantaged households in both these types of settlement. Even though the urban households have higher annual per capita income and education of women (see Appendix Table A2.12) than rural area but, on average, these are very low in both the settlements.

2SLS estimates in Table 2.6 show that, in urban settlement, an additional child reduces children's years of schooling by 0.26 years on average, and it reduces ERT by 0.05 of a unit. The results are statistically significant at the conventional level.

Although the unconditional average educational outcomes of the urban children are higher than the rural children (see Appendix Table A2.11) but the sibling impacts on the educational outcomes of urban children are negative. Such negative causal impacts among urban children could be because the urban women are likely to be more compensating in nature (having higher education than rural women (see Appendix Table A2.12) and are therefore likely to reallocate resources fairly among all children. This means, if there are some children in a family who are of a poor quality then the average educational performance of children in that family will be poor. Investigation on the quality of children is outside the scope of this study.

In rural sub-sample, an additional child reduces the probability of children's school attendance by 3.6 percentage points on average (statistically significant at the 5% level). This could be because rural women prefer sending their sons to work outside home to supplement family incomes in a resource poor household while girls are generally assigned household chores. However, there is a null impact of having siblings on the remaining schooling outcomes. This could be because of a possible reinforcing nature of rural women who are likely to invest more on better quality children and less on poorer quality children as the household resources are limited. Consequently, the positive and negative effects of such investments are likely to be averaged out, causing a null impact. Nature of parents, whether compensating or reinforcing, is clearly something that requires investigation as part of an agenda for future research.

Maralani (2008) also finds a negative sibling impact on years of schooling completion in urban sub-sample while a null impact in rural sub-sample.

Table 2.6: Effect of child-quantity on the schooling outcomes: Urban versus rural

	Urban					Rural				
	Edu. Yrs.	Attend[1].	Delay	ERT[2]	EDT[3]	Edu. Yrs.	Attend.	Delay	ERT	EDT
OLS (Education indicators regressed on No. of children)										
No. of children	-0.292***	-0.027***	0.003	-0.007***	-0.028***	-0.217***	-0.017***	0.004*	-0.006***	-0.019***
	(0.020)	(0.004)	(0.004)	(0.002)	(0.005)	(0.012)	(0.002)	(0.002)	(0.001)	(0.003)
R-squared	0.816	0.100	0.113	0.259	0.079	0.748	0.086	0.123	0.234	0.075
First stage of 2SLS (No. of children on twin births)†										
Twin births	1.032***	1.032***	1.032***	1.004***	1.004***	1.057***	1.057***	1.057***	1.047***	1.047***
	(0.079)	(0.079)	(0.079)	(0.081)	(0.081)	(0.054)	(0.054)	(0.054)	(0.055)	(0.055)
R-squared	0.627	0.627	0.627	0.619	0.619	0.555	0.555	0.555	0.548	0.548
No. of twins	249	249	249	249	249	579	579	579	579	579
Second stage of 2SLS (Education indicators regressed on No. of children)										
No. of children	-0.264**	-0.033	0.021	-0.048***	-0.057	-0.063	-0.036**	-0.020	-0.005	0.014
	(0.118)	(0.024)	(0.026)	(0.017)	(0.041)	(0.074)	(0.017)	(0.016)	(0.011)	(0.029)
F-Statistic	170.204	170.204	170.204	155.398	155.398	384.404	384.404	384.404	363.661	363.661
Observations	13,711	13,711	13,711	13,711	13,711	30,020	30,020	30,020	30,020	30,020

Notes: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Standard errors are reported in parentheses.
Significance of coefficients is based on robust standard error.
[1]Attendance is a dummy variable: if children are absent for less than 15 days, attendance =1, provided they are enrolled in school. [2]ERT is completed years of schooling relative to expected years of schooling at any given age. [3]EDT is age standardised schooling index. †Number of children is instrumented with twin births. Kleibergen-Paap Wald F-statistic. The regression equations control for age of child, age of mother, squared age of mother, education of mother, child gender, child gender*child age, state effects, contraceptive use by either parent (to account for birth spacing), medical treatment location, birth order of children, communities include Brahmin, FC-General, disadvantaged groups (SC, ST and OBC), FC-Muslim and Others (Christians, Sikhs and Jains) are considered as base categories.
Source: Estimates are based on authors' calculations using the survey data.

2.6.4. Schooling outcomes: By gender and types of settlement

Table 2.7, examines the Q-Q trade-off by a gender of the children and a place of residence. In urban settlement, OLS results in the table show that an additional child, on average, reduces boys' (girls') years of schooling by 0.29 (0.29) year, school attendance by 3.6 (2.0) percentage points, ERT by 0.01 (0.01) of a unit and EDT by 0.03 (0.03) of a unit. In rural sub-sample OLS results in the table show that an additional child, on average, reduces boys' (girls') years of schooling by 0.23 (0.21) year, school attendance by 1.5 (1.8) percentage points, ERT by 0.01 (null) of a unit and EDT by 0.03 (0.01) of a unit. The estimates are statistically significant at the conventional levels. Thus, similar negative association between a large size family and educational outcomes is evident for both the genders and in both the settlement types.

2SLS results in the table suggest that an additional child in urban settlement reduces ERT for boys (girls) by 0.04 (0.06) of a unit, on average. These estimates are statistically significant at the 10% and 5% levels respectively. While the trade-off in an educational outcome (i.e, in ERT), is observed among urban children and for both the genders, once again, such a trade-off is not observed within rural sub-sample. In contrast, rural girls experience lesser chances of delay in schooling (by 3.4 percentage points) which is likely to increase their chances of marriage at an early age. The first stage regression is presented in Appendix Table A2.10.

Table 2.7: Effect of child-quantity on the schooling outcomes: Gender difference

	Boy					Girl				
	Edu. Yrs.	Attend[1].	Delay	ERT[2]	EDT[3]	Edu. Yrs.	Attend.	Delay	ERT	EDT
OLS for **urban** sample (Education indicators regressed on No. of children)										
No. of children	-0.293***	-0.036***	-0.007	-0.008**	-0.031***	-0.293***	-0.020***	0.012**	-0.006*	-0.026***
	(0.031)	(0.006)	(0.006)	(0.004)	(0.007)	(0.026)	(0.005)	(0.005)	(0.003)	(0.007)
R-squared	0.813	0.099	0.116	0.258	0.083	0.820	0.111	0.114	0.265	0.082
Observations	7,171	7,171	7,171	7,171	7,171	6,540	6,540	6,540	6,540	6,540
OLS for **rural** sample (Education indicators regressed on No. of children)										
No. of children	-0.226***	-0.015***	0.010***	-0.009***	-0.026***	-0.207***	-0.018***	-0.001	-0.002	-0.012***
	(0.017)	(0.003)	(0.003)	(0.002)	(0.004)	(0.016)	(0.003)	(0.003)	(0.002)	(0.004)
R-squared	0.755	0.086	0.125	0.234	0.068	0.744	0.094	0.123	0.242	0.089
Observations	15,682	15,682	15,682	15,682	15,682	14,338	14,338	14,338	14,338	14,338
Second stage of 2SLS for **urban** sample (Education indicators on regressed on No. of children)										
No. of children	-0.254	-0.028	0.039	-0.036*	-0.051	-0.269	-0.037	0.005	-0.059**	-0.063
	(0.157)	(0.033)	(0.039)	(0.021)	(0.044)	(0.174)	(0.034)	(0.035)	(0.027)	(0.068)
No. of twins	124	124	124	124	124	125	125	125	125	125
F-Statistic	100	100	100	91	91	79	79	79	72	72
Observations	7,171	7,171	7,171	7,171	7,171	6,540	6,540	6,540	6,540	6,540
Second stage of 2SLS for **rural** sample (Education indicators on regressed on No. of children)										
No. of children	-0.135	-0.048	0.001	-0.023	0.002	-0.028	-0.031	-0.034*	0.006	0.020
	(0.126)	(0.030)	(0.031)	(0.018)	(0.052)	(0.091)	(0.019)	(0.018)	(0.013)	(0.035)
No. of twins	282	282	282	282	282	297	297	297	297	297
F-Statistic	154	154	154	147	147	239	239	239	227	227
Observations	15,682	15,682	15,682	15,682	15,682	14,338	14,338	14,338	14,338	14,338

Notes: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Standard errors are reported in parentheses.
Significance of coefficients is based on robust standard error. [1]Attendance is dummy variable: if children are absent for less than 15 days, attendance=1, provided they are enrolled in school. [2]ERT is completed years of schooling relative to expected years of schooling at any given age.[3]EDT is age standardised schooling index including twins. Number of living children is instrumented with twin births. The regression controls for age of child, age of mother, squared age of mother, education of mother, child gender, child gender*child age, state dummies, contraceptive use by either parent, medical treatment location, dummies for birth orders of children, communities include Brahmin, FC-General, disadvantaged groups (SC, ST and OBC), FC-Muslim and Others (Christians, Sikhs and Jains) are considered as base categories. Kleibergen-Paap Wald F-statistic.
First stage regression is reported in Appendix A2.10.
Source: Estimates are based on authors' calculations using the survey data.

2.6.5. Schooling outcomes: Extended versus nuclear family

The extended family is a dummy variable and is assigned a value of *one* if women are living with at least one family member other than their own children or husband if the women are married, or with at least one family member other than the women's own children if women are widowed or divorced or not living with husbands; otherwise a value of *zero* is assigned.

The descriptive statistics of educational outcomes of children by types of family settlement is presented in Appendix TableA2.13. The table shows that the children's educational outcomes are better in nuclear families than in extended families (see Appendix Table A2.13). The mothers are younger in nuclear families although educational attainment of mothers is same in both types of family setting. Average number of children in nuclear families is smaller than in extended families (see Appendix Table A2.14). These are unconditional means. Let us now look at the conditional average effects of siblings on children's educational outcomes that are presented in Table 2.8 for both the types of family setting.

OLS results in the table reveal that an additional child, on average reduces the years of schooling of children in extended (nuclear) family setting by 0.19 (0.20) years, reduces probability of schooling attendance by 2.1 (2.3) percentage points, and ERT by 0.01 (null) of a unit and EDT by 0.02 (0.03) of a unit. These results are statistically significant at the 1% level. Thus, the negative association is evident in both the types of family setting.

2SLS results reveal, on average, that an additional child reduces the probability of school attendance of children by 5.2 percentage points in an extended family setting (marginally significant at the 10% level). However, there is a null impact of siblings on the remaining educational indicators within extended family setting. This could be because children are often assisted by other educated members of their family, which is very common in an extended family setting in India.

However, in a nuclear family setting, an additional child reduces the completed years of children's schooling by 0.12 years on average, and it reduces ERT by 0.02 of a unit. These results are statistically significant at the conventional level. The negative impact of child-quantity on years of schooling and ERT are relevant to a nuclear family setting; this may be due to a lack of adequate time available to women to guide children in education when there are already too many other responsibilities to perform at home, and in absence of additional family members to assist them. This may be more relevant to women who may be working outside the home. This is an interesting hypothesis and could be an agenda for future research.

Table 2.8: Effect of child-quantity on the schooling outcomes: Extended vs. nuclear family

	Extended family setting					Nuclear family setting				
	Edu. Yrs.	Attend[1].	Delay	ERT[2]	EDT[3]	Edu. Yrs.	Attend.	Delay	ERT	EDT
OLS for extended family setting (Education indicators regressed on No. of children)										
No. of children	-0.190***	-0.021***	0.000	-0.012***	-0.019***	-0.204***	-0.023***	-0.000	-0.003	-0.025***
	(0.014)	(0.003)	(0.003)	(0.002)	(0.004)	(0.018)	(0.004)	(0.004)	(0.002)	(0.006)
R-squared	0.752	0.100	0.115	0.223	0.072	0.794	0.072	0.127	0.268	0.083
First stage of 2SLS (No. of children on twin births)†										
Twin births	0.781***	0.781***	0.781***	0.776***	0.776***	1.142***	1.142***	1.142***	1.125***	1.125***
	(0.057)	(0.057)	(0.057)	(0.057)	(0.057)	(0.058)	(0.058)	(0.058)	(0.058)	(0.058)
R-squared	0.670	0.670	0.670	0.669	0.669	0.696	0.696	0.696	0.689	0.689
No. of twins	397	397	397	397	397	431	431	431	431	431
Second stage of 2SLS (Education indicators regressed on No. of children)										
No. of children	-0.032	-0.052*	-0.030	-0.010	0.033	-0.120*	-0.027	-0.000	-0.022**	-0.026
	(0.135)	(0.028)	(0.027)	(0.018)	(0.051)	(0.070)	(0.017)	(0.018)	(0.011)	(0.027)
F-Statistic	187.848	187.848	187.848	183.379	183.379	392.638	392.638	392.638	377.421	377.421
Observations	23,477	23,477	23,477	23,477	23,477	20,254	20,254	20,254	20,254	20,254

Notes: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$. Standard errors are reported in parentheses.
Significance of coefficients is based on robust standard error. [1]Attendance is dummy variable: if children are absent for less than 15 days, attendance=1, provided they are enrolled in school. [2]ERT is completed years of schooling relative to expected years of schooling at any given age.[3]EDT is age standardised schooling index including twins. Number of living children is instrumented with twin births. The regression controls for age of child, age of mother, squared age of mother, education of mother, child gender, child gender*child age, state, dummies, age gap between the first and last children, medical treatment location, dummies for birth orders of children, communities include Brahmin, FC-General, disadvantaged groups (SC, ST and OBC), FC-Muslim and Others (Christians, Sikhs and Jains) are considered as base categories. Kleibergen-Paap Wald F-statistic.
Source: Estimates are based on authors' calculations using the survey data.

2.6.6. Schooling outcomes: Robustness checks

Some additional controls:

I have used some additional control variables, namely age gap between the first and last children in a family, birth order of children and contraceptive use by either of the parents; I find that the results are robust (compare Table 2.4 and Appendix Table 5.1).

The age gap between the oldest and youngest child in a family is controlled for two reasons. *First*, a larger age gap indicates lesser possibility of a woman's future fertility. *Second*, when the age gap is high, it is likely that the oldest child in a family will take care of the younger siblings' education. So, the negative effect of birth spacing may be controlled using this variable.

To address a concern relating to unobserved parental preference for a child, I use the information on contraceptive use by either of the parents as an additional control variable. Contraceptive use is a binary variable and is assigned a value of *one* if either of the parents of a child use any kind of contraceptive methods, otherwise it is assigned a value of *zero*. The results are similar to the earlier estimates (compare Table 2.4 and Appendix Table 5.1).

Birth order has an independent effect on children's educational outcomes (Black et al., 2005; Angrist et al., 2005). Therefore, it is essential to control for the birth order of children otherwise the results are likely to be biased. By controlling the birth order of children, I find the results are robust (see Table 2.4); the robustness of the estimates is consistent with the findings by Li et al. (2008) (for Chinese children) and Kumar and Kugler (2017) (for Indian children). In contrast, Black et al. (2005) (for Norwegian children) and Angrist et al. (2005) (for Israeli children) find that the impact of child-quantity on children's educational outcomes becomes negligible when the birth order of children is controlled.

Alternative instrument: Same gender composition of first two children

Parents having the first two children of same gender are more likely to desire another child of the opposite gender. This is likely to increase the number of children in a family. The instrument, i.e., *same gender composition of first two children*, is a binary variable and is assigned a value of *one* if the first two children born to the mother are either both girls or both boys; otherwise, a value of *zero* is assigned. The sample is therefore restricted to mothers with at least two children.

The first five columns of Appendix Table A2.16 present the results for using *twins* as an instrument for child-quantity while last five columns present the results for using *same gender composition* as an instrument for child-quantity. Here, I interpret the results for the *same-gender composition* of children; the results for twins are in parentheses. On average, an additional child reduces completed years of schooling by 0.62 (0.12) years, the probability of school attendance by 4.2 (3.2) percentage points, ERT by 0.04 (0.02) of a unit and EDT ratio by 0.08 (0.01) of a unit. The results are statistically significant at the conventional levels.

In a developed country setting, Black et al. (2005) do not find any quantity-quality trade-off by using *same gender composition of first two children* as an instrument, although they find the trade-off by using *twins* as an instrument. Angrist et al. (2005) find similar results as Black et al. (2005) using the same instrument.

Reasons behind the difference in the estimates: twins versus same gender composition

The results in Appendix Table A2.16 show that the estimates of child-quantity, i.e., β'' on children's schooling outcomes using *twins*, are consistently smaller than the corresponding estimates using *same gender composition*. When *twins* are used as an instrument, β'' estimate in Equation 2.10 is an effect of an extra child on schooling outcomes of children in families that are affected by multiple births. Similarly, β'' estimate for *same gender composition* gives the average effect of an extra child on schooling outcomes of children in families that are affected by children's same gender composition. For these reasons, *twin births* and *same* *gender composition* do not necessarily identify the same average effects. These differences in the estimates strongly suggest that the two types of fertility shock have different local average treatment effects. Hence, the difference in the estimates is mainly due to a local average treatment effect that is very much instrument specific.

Furthermore, a smaller effect with twins can be explained by the following reasons: First, let us assume that the n^{th} child is of the same age in both twin and non-twin families. In a twin family where n^{th} and $(n+1)^{\text{th}}$ children are twins, the $(n+1)^{\text{th}}$ child from a twin family would be older than $(n+1)^{\text{th}}$ child in a non-twin family; this is because it would take at least a year to have $(n+1)^{\text{th}}$ child in a non-twin family. Therefore, the average age of children in twin family is expected to be higher than in a non-twin family. The difference in the average age of children has implications on educational attainments. Thus negative effects of an additional child on educational outcomes using twins as an instrument are likely to be smaller in magnitude because children are older in twin families compared to non-twin families. Second, there are economies of scale in parenting two children of same age (Angrist and Evans, 1998). However, poor health endowment for twin children could have negative effect on schooling outcomes (Rosenzweig and Zhang, 2009). Therefore, the net effect of *twins* as an instrument will depend on how the two opposite effects balance each other.

2.6.7. Effect of child-quantity on the health outcomes

OLS results in Table 2.9 shows that an additional child increases height-for-age z-score for young children by 0.12 of a standard deviation on average. For school-aged children, an additional child reduces weight-for-age z-score by 0.02 of a standard deviation on average, height-for-age z-score by 0.02 of a standard deviation on average and BMI-for-age z-score by 0.04 of a standard deviation on average.

2SLS estimates in the table reveal that an additional child reduces weight-for-age z-score for young children by 0.5 of a standard deviation on average. An additional child reduces BMI-for-age z-score for school-aged children by 0.2 of a standard deviation on average. Unconditional average z-scores are reported in the footnote of Table 2.9. The results are statistically significant at the conventional levels. These results suggest that there is a negative sibling effect on children's health in both age groups. However, we need caution while interpreting these results because of a potential selection bias in both age groups. The selection possibility is discussed at the end of Section 2.4.3. Hence, these results may not be precise and it requires further research.

Same-gender composition has not been used as an alternative instrument to study health outcomes because it may have direct impact on health outcomes of children (Pande, 2003a).

Table 2.9: Effect of child-quantity on the health outcomes

	Age 1-4			Age 5-18		
	z-score weight for age	z-score height for ages	z-score BMI for ages	z-score weight for age[1]	z-score height for ages	z-score BMI for ages
OLS (Z-scores regressed on No. of children)						
No. of children	0.048	0.121**	-0.050	-0.022*	-0.024***	-0.041***
	(0.038)	(0.060)	(0.045)	(0.013)	(0.008)	(0.007)
R-squared	0.081	0.060	0.062	0.084	0.062	0.071
First stage of 2SLS (No. of children regressed on twin births)†						
Twin births	1.000***	1.000***	1.000***	0.921***	0.970***	0.970***
	(0.152)	(0.152)	(0.152)	(0.060)	(0.047)	(0.047)
R-squared	0.817	0.817	0.817	0.725	0.662	0.662
No. of twins	33	33	33	245	623	623
Second stage of 2SLS (Z-scores regressed on No. of children)						
No. of children	**-0.495****	-0.413	-0.381	-0.123	0.019	**-0.228*****
	(0.234)	(0.329)	(0.281)	(0.100)	(0.057)	(0.058)
F-Statistic	43	43	43	239	433	433
Observations	2,099	2,099	2,099	14,336	34,849	34,849

Notes: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Standard errors are reported in parentheses.
Significance of coefficients is based on robust standard error.
[1]Weights are measured by WHO for children until age 10.08. †In the first stage regression number of children is regressed on twin births which is used as an instrument.
Regression equations control for age of child, age of mother, squared age of mother, education of mother, child gender, child gender*child age, medical treatment location, state dummies, communities include Brahmin, FC-General, disadvantaged groups (SC, ST and OBC), FC-Muslim and Others (Christians, Sikhs and Jains) are considered as base categories. Age gap and birth order of children are additional controls used. 1R-squared is reported for first stage of 2SLS. Kleibergen-Paap Wald F-statistic is reported.
Children (1–4 years): Overall sample mean z-scores: weight (-1.59); height (-1.88); weight for length/height (-0.69);
Children (5–18 years): Overall sample mean z-scores: weight (-1.51); height (-1.54); BMI (-0.99).
Source: Estimates are based on authors' calculations using the survey data.

2.6.8. Health outcomes: Urban versus rural settlement

For young children, within urban sub-sample, OLS results show that there is no association between number of siblings and health outcomes. However, 2SLS result shows that an additional child increase height-for-age z-score by 1.3 standard deviations. Thus the positive sibling effect on health of urban young children could be because the majority of urban households (83%) have at the most 3 children (61% have at the most two children and 21.5% have three children). Only 17% of households have 4 or more children. So the trade-off may be less likely in the urban sub-sample. Within rural sub-sample, an additional child, on average, increases the weight-for-age z-score for young children by 0.08 of a standard deviation and it increases height-for age z-score by 0.2 of a standard deviation. In contrast, 2SLS results show that, on average, an additional children reduces weight-for-age z-score for young children by 1.1 standard deviations, it reduces height-for-age z-score by 1.5 standard deviations. Hence, the OLS results are likely to be biased and 2SLS results suggest that there is a negative sibling-effect on health of rural young children. This could be because a larger percentage of rural households (29%) have 4 or more children than urban households (17%) and this is more so in the extended families. There are 24% (13%) of rural (urban) extended families that have four or more children (including young children). Hence, the trade-off is likely to be arising from an extended family setting in rural areas (see results for extended family setting in Table 2.11).

For school-aged children, within urban sub-sample, an additional child reduces height-for-age z-score by 0.05 of a standard deviation on average and it reduces their BMI-for-age z-score by 0.08 of a standard deviation on average. The results suggest that there is a negative association between the number of siblings and health of school-aged children. However, there is no causal relationship found within urban sub-sample. Within rural sub-sample, OLS (2SLS) result shows that an additional child reduces BMI-for-age z-score for school-aged children by 0.02 (0.23) of a standard deviation on average. These results are statistically significant at the 1% level. Similar to rural young children, there is a similar negative sibling effect on health of rural school-aged children. This could be because the number of children is higher on average in rural than in urban sub-sample (see Appendix Table A2.12). Besides, households with four or more children is higher in rural (45%) than in urban households (32%) and this is more so in extended families.

Table 2.10: Effect of child-quantity on the health outcomes by type of residence

	Age 1-4			Age 5-18		
	z-score weight for age	z-score height for ages	z-score BMI for ages	z-score weight for age[1]	z-score height for ages	z-score BMI for ages
OLS (Z-scores regressed on No. of children): **Urban**						
No. of children	0.004	0.067	-0.064	-0.033	-0.047***	-0.075***
	(0.078)	(0.128)	(0.092)	(0.028)	(0.015)	(0.015)
Observations	614	614	614	4,074	10,814	10,814
R-squared	0.119	0.097	0.123	0.122	0.071	0.083
OLS (Z-scores regressed on No. of children): **Rural**						
No. of children	0.079*	0.164**	-0.043	0.000	-0.013	-0.021***
	(0.044)	(0.069)	(0.052)	(0.015)	(0.009)	(0.008)
Observations	1,485	1,485	1,485	10,262	24,035	24,035
R-squared	0.096	0.064	0.079	0.060	0.060	0.063
First stage of 2SLS (No. of children regressed on twin births)†: **Urban**						
Twin births	1.197***	1.197***	1.197***	0.849***	0.847***	0.847***
	(0.381)	(0.381)	(0.381)	(0.125)	(0.083)	(0.083)
No. of twins	11	11	11	59	182	182
Observations	614	614	614	4,074	10,814	10,814
R-squared	0.828	0.828	0.828	0.746	0.706	0.706
First stage of 2SLS (No. of children regressed on twin births)†: **Rural**						
Twin births	0.875***	0.875***	0.875***	0.932***	1.021***	1.021***
	(0.142)	(0.142)	(0.142)	(0.066)	(0.055)	(0.055)
Observations	1,485	1,485	1,485	10,262	24,035	24,035
R-squared	0.818	0.818	0.818	0.717	0.647	0.647
No. of twins	22	22	22	186	441	441
Second stage of 2SLS (Z-scores regressed on No. of childrens): **Urban**						
No. of children	0.403	**1.282***	-0.621	-0.305	0.106	-0.203
	(0.437)	(0.734)	(0.576)	(0.199)	(0.118)	(0.126)
F-Statistic	10	10	10	46	105	105
Observations	614	614	614	4,074	10,814	10,814
Second stage of 2SLS (Z-scores regressed on No. of childrens): **Rural**						
No. of children	**-1.080*****	**-1.486*****	-0.253	-0.042	0.015	**-0.227*****
	(0.276)	(0.357)	(0.317)	(0.117)	(0.064)	(0.066)
F-Statistic	38	38	38	197	351	351
Observations	1,485	1,485	1,485	10,262	24,035	24,035

Notes: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Standard errors are reported in parentheses.
Significance of coefficients is based on robust standard error.
[1]Weights are measured by WHO for children until age 10.08. †In the first stage regression number of children is regressed on twin births which is used as an instrument.
Regression equations control for age of child, age of mother, squared age of mother, education of mother, child gender, child gender*child age, state dummies, medical treatment location, communities include Brahmin, FC-General, disadvantaged groups (SC, ST and OBC), FC-Muslim and Others (Christians, Sikhs and Jains) are considered as base categories. Age gap and birth order of children are additional controls used. 1R-squared is reported for first stage of 2SLS. Kleibergen-Paap Wald F-statistic is reported. Children (1–4 years): urban sample mean z-scores: weight (-1.67); height (-1.96); BMI (-0.73); Rural sample mean z-scores: weight (-1.67); height (-1.96); BMI (-0.73); Children (5–18 years): Urban sample z-scores: weight (-1.22); height (-1.43); BMI (-0.74); Rural sample z-scores: weight (-1.68); height (-1.63); BMI (-0.08).
Source: Estimates are based on authors' calculations using the survey data.

The positive health outcomes in urban settlement while negative outcome is rural settlement could be because it is difficult to access medical centres in rural areas due to its distant location. Appendix Table A2.12 shows that the medical locations in urban settlement are mostly located in the same town while in rural settlement it is located in another village.

2.6.9. Health outcomes: Extended versus nuclear family

Extended families on average have larger number of children than nuclear families (see Appendix Table A2.14). Therefore, Q-Q trade-off is likely to be visible in an extended family setting. Nuclear families may have lower number of children on average but these families have no additional member (other than married couples, widowed or divorced women) to look after the children or to help with household chores. Hence, Q-Q trade-off is equally likely in such as setting.

For young children, within an extended family setting, OLS results in Table 2.11 show that there is no association between number of siblings and health outcomes. In contrast, 2SLS results for extended family setting show that an additional child reduces weight-for-age z-score and height-for-age z-score by 0.7 of a standard deviation on average. Thus the hypothesis in the previous section, that the negative sibling impact on health of rural young children could arise from an extended family setting, may be true.[20] Within a nuclear family setting, OLS results show that there is a positive association between number of siblings and health of young children: an additional child increases weight-for-age z-score by 0.1 of a standard deviation and height-for-age z-scores by 0.3 of a standard deviation. However, no causal relation is found.

For school-aged children, within an extended family setting, OLS results show that an additional child, on average, reduces height-for-age z-score by 0.02 of a standard deviation and

[20]Further subdivision of a sample by settlement and family types may not be feasible due to limited observations. Besides, the strength of the instrument will be questionable for such a small sample size.

BMI-for-age z-score by 0.04 of a standard deviation. 2SLS result shows that an additional child, on average, reduces a BMI-for-age z-score by 0.2 of a standard deviation. Thus, there exists a similar negative sibling effect on school-aged children's health arising from extended family setting, as for young children. Within a nuclear family setting, OLS results show that there is a negative association between number of siblings and health of school-aged children: an additional child reduces weight-for-age z-score and height-for-age z-score by 0.04 of a standard deviation and BMI-for-age z-scores by 0.05 of a standard deviation. 2SLS result show that an additional child, on average, reduces a BMI-for-age z-score by 0.2 of a standard deviation. The results are statistically significant at the conventional levels and suggest that there is a negative sibling effect on health of school-aged children in both the extended and nuclear family settings.

These above results, however, should be interpreted with caution due to a possible sample-selection issue as discussed at the end of Section 2.4.3.

Table 2.11: Effect of child-quantity on the health outcomes

	Age 1-4			Age 5-18		
	z-score weight for age	z-score height for ages	z-score BMI for ages	z-score weight for age[1]	z-score height for ages	z-score BMI for ages
OLS (Z-scores regressed on No. of children): **Extended family**						
No. of children	-0.006	0.019	-0.034	-0.016	-0.021**	-0.035***
	(0.051)	(0.082)	(0.059)	(0.018)	(0.010)	(0.009)
Observations	1,192	1,192	1,192	7,595	18,627	18,627
R-squared	0.085	0.072	0.079	0.089	0.064	0.066
OLS (Z-scores regressed on No. of children): **Nuclear family**						
No. of children	0.112**	0.254***	-0.078	-0.038*	-0.042***	-0.049***
	(0.056)	(0.089)	(0.073)	(0.021)	(0.014)	(0.013)
Observations	907	907	907	6,741	16,222	16,222
R-squared	0.105	0.094	0.099	0.085	0.064	0.080
First stage of 2SLS (No. of children regressed on twin births)†: **Extended family**						
Twin births	1.599***	1.599***	1.599***	0.742***	0.774***	0.774***
	(0.260)	(0.260)	(0.260)	(0.076)	(0.063)	(0.063)
No. of twins	12	12	12	111	291	291
Observations	1,192	1,192	1,192	7,595	18,627	18,627
R-squared	0.810	0.810	0.810	0.746	0.670	0.670
First stage of 2SLS (No. of children regressed on twin births)†: **Nuclear family**						
Twin births	0.742***	0.742***	0.742***	1.103***	1.149***	1.149***
	(0.109)	(0.109)	(0.109)	(0.089)	(0.067)	(0.067)
Observations	907	907	907	6,741	16,222	16,222
R-squared	0.846	0.846	0.846	0.730	0.699	0.699
No. of twins	21	21	21	134	332	332
Second stage of 2SLS (Z-scores regressed on No. of childrens): **Extended family**						
No. of children	-0.714***	-0.694**	-0.435	-0.042	0.190*	-0.245**
	(0.169)	(0.352)	(0.264)	(0.151)	(0.099)	(0.103)
F-Statistic	38	38	38	96	151	151
Observations	1,192	1,192	1,192	7,595	18,627	18,627
Second stage of 2SLS (Z-scores regressed on No. of childrens): **Nuclear family**						
No. of children	-0.184	-0.191	-0.125	-0.137	-0.055	-0.221***
	(0.439)	(0.554)	(0.505)	(0.128)	(0.069)	(0.070)
F-Statistic	46	46	46	152	295	295
Observations	907	907	907	6,741	16,222	16,222

Notes: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Standard errors are reported in parentheses.
Significance of coefficients is based on robust standard error. [1]Weights are measured by WHO for children until age 10.08. †In the first stage regression number of children is regressed on twin births which is used as an instrument. Regression equations control for age of child, age of mother, squared age of mother, education of mother, child gender, child gender*child age, state dummies, medical treatment location, communities include Brahmin, FC-General, disadvantaged groups (SC, ST and OBC), FC-Muslim and Others (Christians, Sikhs and Jains) are considered as base categories. Age gap and birth order of children are additional controls used. Children (1-4 years): Extended family mean z-scores: weight (-1.54); height (-1.80); BMI (-0.68); Nuclear family mean z-scores: weight (-1.66); height (-1.98); BMI (-0.69). Children (5-18 years): Extended family mean z-scores: weight (-1.51); height (-1.54); BMI (-0.99); Nuclear family mean z-scores: weight (-1.60); height (-1.60); BMI (-0.96).
Source: Estimates are based on authors' calculations using the survey data.

2.7. Discussion and conclusions

This study empirically tests the theoretical model of child quantity-quality trade-off that has been formulated by Becker and Lewis (1973). Child-quantity is measured by the number of surviving children residing with a mother and child-quality is measured by schooling and health outcomes. Using the IHDS-II dataset, I have constructed wide-ranging indicators for measuring child-quality. For schooling outcomes of children between the ages of 5–18, I have used the following indicators: a) *completed years of schooling*; b) *school attendance* if a child is currently enrolled in school (binary variable); c) *delay in years of schooling* if a child is currently enrolled in school (binary variable); d) *ratio of actual years of schooling to expected years of schooling* at a given age (ERT); e) *age-standardised schooling index* (EDT); f) *test scores in reading, writing and arithmetic*; the score categories are available for children between the ages of 8–11 and are converted to binary variables. The child health indicators are assessed in accordance to child growth standards of World Health Organisation (WHO) and these include i) *weight-for-age z-score*, ii) *height-for-age z-score*, iii) *BMI-for-age z-score*. I have used two different age groups of children i.e., 1–4 and 5–18 to analyse the sibling impact on health outcomes.

Given the endogenous nature of fertility, testing the existence of this trade-off is indeed challenging. To control for the endogeneity of child-quantity variable, I have used an instrumental variable approach where twins (i.e., whether a mother has twin children or not) is used as an instrument for child-quantity. Using twins as an instrument for child-quantity, I find that an extra child in a family, on average, lowers the completed years of schooling by 0.12 years, reduces the chances of school attendance by 3.6 percentage points, and it reduces the ratio of actual years of schooling to expected years of schooling by 0.02 of a unit. These findings are robust to controlling for birth order of children, age gap of children and contraceptive use by either of the parents. In the aspect of heath, the children between the ages of 5–18 experience a loss of 0.23 of a standard deviation in BMI-for-age z-score, on average, due to an extra sibling, whereas children between the ages of 1–4 experience a loss of 0.50 of a standard deviation in weight-for-age z-score due to an extra sibling. The empirical findings show that the negative impact of having a large family size on years of schooling is relevant to the urban settlement and the nuclear family setting. The negative sibling impacts on health outcomes are relevant to the rural settlement and to both the extended and the nuclear family setting. The positive health outcomes in urban settlement while negative outcome is rural settlement could be because it is difficult to access medical centres in rural areas due to its location. Appendix Table A2.12 shows that the medical locations in the urban settlement are mostly located in the same town, while those in the rural settlement are located in another village.

Given that families with different number of children may experience different schooling outcome, I consider different sub-samples of families with different number of children. Using n^{th} order of twin delivery as an instrument, my findings reveal that the families with at least three children have positive sibling effects on the schooling outcomes (namely years of schooling, ERT and EDT), whereas families with five or more children experience negative sibling effect on the schooling outcomes (namely years of schooling, delay, ERT and EDT). I further test the robustness of the results using *same-gender composition of children* for families with at least two children and compare the results with *twins*. I find that the magnitude of the trade-off using *same gender composition* is higher compared to *twins*.

The policies that talk about this trade-off are already in place, such as provision of schools for children, universal income subsidies to poor families, public health improvements through expenditure on sanitation and mass immunisation. All these policies have favourable repercussions on children through an increase in school attendance, reduction in educational expenditure, reduction in children's labour market participation, improvement in children's nutritional requirement, reduction in child mortality and, at the same time, discouraging parental fertility (Cigno et al., 2001). Despite the implementation of such policies and the initiation of RTE Act of 2009, the drop-out rates have remained high at all levels of schooling in India. The finding in this study reveals the existence of trade-off among urban children in years of schooling attainments. In India, policy goals are primarily focused on improving the quantity of schools and increasing school enrolments in rural areas; however, at the same time it should also consider improving the quality of schooling in both rural and urban areas. This is because government education in India is free for all but is generally of poor quality in terms of both teacher input, school resources and infrastructure (Kingdon, 2007). In addition, a finding in this study reveals that an additional child reduces the probability of school attendance in rural areas by 4 percentage points. This finding is consistent with the Ministry of Human Resource Development report (MHRD, 2003, 2014).[21] Although, 100% school enrolment has been achieved but improving the quality of schools and the attendance of children are yet to be achieved and hence, they are of policy relevance.

For future research, it would be interesting to understand how parents reallocate their resources among children after twin births in order to study how such reallocations may influence child-quality as motivated by (Li et al., 2008). Given that there is a possibility of a selection issue in the health sample, further investigation is essential as a part of an agenda for future research.

[21] MHRD (2003) finds that, when student's attendance is measured at several points in the year, attendance varies from 43% to very high rates of over 90% (Kingdon, 2007). The Government of India (G.O.I) aiming to improve school attendance through several policies and programmes, such as Right of Children to Free and Compulsory Education (RTE) Act of 2009 that aims to provide free elementary education to ensure compulsory admission, attendance and completion of elementary education by every child between 6–14 years of age (MHRD, 2014).

Chapter 3. The Impact of Fertility on Female Labour Market Outcomes: Evidence from India

3.1. Introduction

A vast literature in labour economics over the past 20–30 years has questioned why women are under-represented in the labour market in both developed and developing countries. Among several socio-economic factors, an observed fact is that women disproportionately assume child-rearing responsibilities has always been recognised in the labour economics literature (Waldfogel, 1998; Piras and Ripani, 2005). The related studies in the past have tried to explore several factors (such as fertility and unearned family wealth) that discourage female labour market participation. The studies have also investigated how an incentive, such as a wage rate influences female time-allocation in different activities, such as housework, market-work and leisure. This broad division of time into the three types of regular activities is known as the *trichotomy of time allocation* in the labour economics literature. Theoretical study based on the *trichotomy of time allocation* by married women has been motivated by Gronau (1977).

Gronau assumes that, in a developed country setting, a woman may choose to spend *zero* hours at home and may allocate her total time between market-work and leisure. I modify this assumption in my work to reflect a more realistic context. I assume that a woman spares some compulsory minimum amount of time at home such that hours spent at home is strictly positive, instead of a *zero* possibility. Hence, I have refined Gronau's original proposition on a woman's equilibrium allocation of hours into house-work, market-work and leisure by introducing an additional time-constraint: *compulsory house-work time requirement*. By incorporating the constraint into the model, I show how the optimal hours of labour supply in the market may decline below Gronau-equilibrium hours of labour supply. I further show that, depending on the relative magnitude of the shift in the constraint (i.e., *compulsory house-*

work time requirement) from its reference point due to an exogenous shock, for example, a fertility shock, there could be a possibility of a *sub-optimal* solution that may cause a working woman to exit the labour market.

To empirically examine the impact of exogenous fertility shock on female labour market outcomes, I instrument fertility using *twins*, following Bronars and Grogger (1994). To improve the strength of the causal interpretation, I also use an alternative instrument: *first-born girl*.[22] So far, the related studies in the Indian context have not examined the causal impact of fertility on female labour market outcomes.

In addition to fertility, there are several other determinants of female labour market outcomes that are also considered for empirical analyses. The economics determinants include wage rate and unearned family wealth.[23] The demographic variables include female age, female age at marriage, female education, female marital status, place of residence, caste, religion etc.

Using the IHDS-II dataset, the primary findings reveal that fertility discourages female labour market participation and longer hours of labour supply, particularly when children are young (below the age of six). An additional young child, on average, reduces female labour market participation by 11 percentage points and it reduces annual hours of labour supply by approximately 200 hours.[24] The negative impact of young children on female labour market participation is evident in the urban area and in the nuclear family setting. The negative impact of young children on hours of work in the market is relevant to both the types of set-

[22]The latter instrument is suitable in the Indian context because of a strict 'son' preference by Indian parents. Such a preference is guided by a cultural practice where a son is considered as future security for parents at their retirement ages. Maertens (2013) finds that the parental aspiration for girls is sensitive to social norm such as age of marriage while aspiration for sons is sensitive to returns to higher education. That is why girl are force to marry at the early age while boys are allowed to achieve higher education in expectations of higher returns from their higher education. Therefore, having a *first-born girl* is likely to encourage Indian parents to have another child of an opposite gender.

[23]For graphical illustrations of hourly wage and unearned wealth effects on time allocation, see Gronau (1977), pp. 1107–08.

[24]Similar negative impacts are found for the sample of women who have both young and school-aged children Appendix Table A3.50.

tlement (urban and rural) and to both the types of family setting (extended and nuclear). In contrast, school-aged children encourage female labour market participation, although they have null effect on average hours of labour supply. In addition to my primary focus on the fertility impact, the study examines the impacts of hourly wage and family wealth on the outcomes; the findings are consistent with the theoretical predictions of Blundell and MaCurdy (1999), which are typically relevant for a developed country context.

The remainder of the paper is organised as follows. Section 3.2 provides the contextual background while discussing the related studies in the literature that motivate this study. I then expand on the studies relating to the Indian context and underscore the relevant contribution to the gaps in the existing literature. Section 3.3 presents Gronau's original theoretical model, amendment to the Gronau-equilibrium condition and I graphically demonstrate how a woman's time-allocation may change due a new-born child. Section 3.4 presents the data and the descriptive statistics of the sample. Section 3.5 discusses the empirical strategy and identification, while Section 3.6 presents the main results. Finally, Section 3.7 discusses the key findings, caveats of the study and concludes with policy implications and avenues for future research.

3.2. Contextual background

At first, I provide a broad overview of the related studies in the labour economics literature. I narrow down my focus to the Indian context to reflect on India's standing in terms of the number of births per woman and female labour market participation during 2011-12; discuss the possible reasons for such decline in the participation rate. Finally, with the understanding of the current Indian scenario and by identifying possible gaps in the literature, I outline my contributions.

3.2.1. Literature review

In this section, I review some recent studies that discuss how social, economic and political factors may impact female labour market participation across different countries. These factors include welfare policies, demographic features, fertility (i.e., number of children born per woman), labour market features (such as wage rate, minimum wage and gender-gap in wage), travel or transport costs, public care provisions and culture. I discuss these determining factors of female labour market participation sequentially below.

Impact of welfare policies on female labour market participation:

According to Esping-Andersen et al. (2002) and Jensen (2017), female labour market participation has increasingly been justified in economic terms as more women in the labour market will increase the number of taxpayers, thereby ensuring the sustainability of a welfare state. Welfare policies have evolved to make the European countries most competitive and the most dynamic knowledge-based economy in the world (such as the 10-year Lisbon Strategy, adopted in 2000). These policies have aimed to increase female labour market participation by more than 60% by 2010 in order to promote equality of opportunity, higher productivity and a higher standard of living for all (Caruana, 2006). Welfare and taxation policies have mixed impacts on female labour market participation. For example, the state welfare policies aiming at increasing the number of tax-payers and making provisions for public childcare and elder-care facilities have encouraged female participation in the labour market. On the other hand, the higher taxation (such as progressive taxation) that eats away the utility of working by cutting a large chunk of obtainable wages discourages women from participation in the labour market (Keeley, 1981; Summers et al., 1993; Jepsen et al., 1997).

Impact of demographic features on female labour market participation:

Demographic variables, such as age, health and education are primary predictors of female labour market participation (OECD, 1989; Gustafsson et al., 1996; England et al., 2012;

Grunow et al., 2012). Household composition has continued to play a vital role towards female participation decision and work-time because the household is the basic unit for decision-making (Becker, 1965). For example, in a household, whether a woman will offer to participate in the labour market depends on her marital status, economic-status of her household and family income (Hakim, 2002; Matysiak and Steinmetz, 2008; Stähli et al., 2009). Within a household, a woman with a low-earning spouse is more likely to participate in the labour market than a woman with a high-earning spouse (Jensen, 2017).

Impact of fertility on female labour market participation:

The association between fertility and female labour supply has been extensively researched since the 1970s, especially within the context of developed countries, where notable contributions reveal positive, negative as well as null effects. The contributions by Bell (1974), Schultz (1978), Smith-Lovin and Tickamyer (1978), Lehrer and Nerlove (1984) and Vere (2007) reveal a negative association between fertility and female labour supply. In contrast, Cain and Dooley (1976), Cogan (1981), Carliner et al. (1984) and Fleisher and Rhodes (1979) find positive associations. DeFronzo (1980) and Link and Settle (1981), nevertheless, do not find any association between fertility and female labour supply. The magnitude of the association between fertility and female labour supply is, however, observed to be much smaller in developing countries compared to developed countries; this is partly due to the availability of inexpensive and accessible childcare alternatives in developing countries (Stycos and Weller, 1967). For instance, in many developing countries, childcare responsibilities are often shared by grandparents and other available household members in an extended family setting. Studies exploring these associations, however, do not establish causality given that the fertility decisions are endogenous and are influenced by a variety of unobserved factors. In addition, some studies find an existence of a reverse causality.[25]

A number of studies have exploited an exogenous variation in fertility to establish a causal

[25] For example, Smith-Lovin and Tickamyer (1978) find that fertility has a negative impact on female labour market participation, whereas female labour market participation has a positive impact on fertility.

relationship between the number of children and female labour market outcomes by considering different instruments for fertility. For example, the use of *twins* as an instrument has been exploited by Bronars and Grogger (1994) and Jacobsen et al. (1999). Alternatively, the *same-gender composition of first two children* (i.e., whether a mother has the first two children of the same gender) has been used by Angrist and Evans (1998) and Cruces and Galiani (2007). Bronars and Grogger (1994) use *twins* as instruments for fertility and find it exerts a negative impact on single (i.e., unwed) women's performance in the labour market in the United States. Angrist and Evans (1998) exploit *same-gender composition* and find a negative impact of fertility on female labour market outcomes in the Unites States, while Agüero and Marks (2008) use infertility as an instrument and find no impact of fertility on female labour market participation in the context of Latin American countries.

Impact of labour market features on female labour market participation:

There are numerous studies in the literature that have analysed the extent to which labour market features (such as the wage rate, minimum wages and gender gap in wages) have impacted on the female labour supply. For example, Cloïn et al. (2011) find that a high minimum wage stimulates the female labour market participation of low-educated women. However, wage cannot solely explain the female labour market outcome. Financial incentives together with occupational characteristics (i.e., service economy) can determine labour market outcomes. For example, the service economy is more open towards female workers in European countries (Pissarides et al., 2005) and, more importantly, the flexibility to work part-time has increased orientation of women towards the service sectors (Jaumotte, 2003; Caruana, 2006; Plantenga and Remery, 2009). This flexibility allows for the reconciliation between work and care obligations.

In the United States, past studies find that wage rate has a positive impact on female labour supply (Cain and Weininger, 1973; Lehrer and Nerlove, 1981, 1982; Dooley, 1982; Carliner et al., 1984; Moffitt, 1984; Rosenzweig and Schultz, 1985). In regard to the impact of unearned family income on female labour market participation, the empirical results are mixed. Schultz (1980) finds a depressing impact of a husband's income on female labour force participation, which is less pronounced for the youngest age cohort (14–24 years). In a similar way, Lehrer and Nerlove (1981) and Lehrer and Nerlove (1982) report that a husband's income has a significant effect only after the onset of child-bearing. Bean et al. (1982) assume that the role incompatibility between mother and worker decreases when husband's income decreases. However, the empirical results are mixed; while such assumptions are found to hold true for Mexican Americans, they do not hold true for Puerto Rican and Cuban women.

Impact of travel cost and distance to work on female labour market participation:

Buckner (2009) finds affordable travel costs influence the decision-making of women on whether to participate in the labour market or not. Similarly, Yeandle (2009) finds women generally prefer to work locally. In addition, women who work close to their homes and on a part-time basis experience less conflict between the mother and worker roles (Lehrer and Nerlove, 1986).

Impact of the service economy and public care provisions on female labour market participation:

In urban areas, the localities possessing a strong service economy as well as provision of social services (such as childcare and elder-care) have continued to have positive impact on female labour market participation (Trydegård and Thorslund, 2010; Jensen and Lolle, 2013). Research studies based on welfare policies have strongly argued that the public childcare provisions and elder-care institutions are major drivers of female employment prospects (Daly and Lewis, 1998; Lewis, 2002; Kangas and Rostgaard, 2007; Hegewisch and Gornick, 2011; Pfau-Effinger and Rostgaard, 2011).

Impact of culture on female labour market participation:

Culture plays a crucial role for women's decision-making on whether to participate in the labour market or not. For example, in a developing country, such as India, the restrictions on activities of women are a throwback to cultural regimes of the past where women working with men outside the household is frowned upon, especially for married women (Eswaran et al., 2013). Even in developed countries, cultural norms discourage female labour market participation in a different way. For example, in Finland and Germany, there is a widely held belief that a caring and loving mother will take care of their own children without putting them in childcare facilities. Such a belief also discourages mothers from using public childcare provisions and consequently from the labour market participation (Kröger et al., 2003; Mätzke and Ostner, 2010). However, cultural ideals may not be homogenous within an entire nation because the ideals may vary across societies, localities and communities. Within a given national culture, divergence and even contradictory values and ideals may co-exist (Harris, 1983; Jensen, 2017).

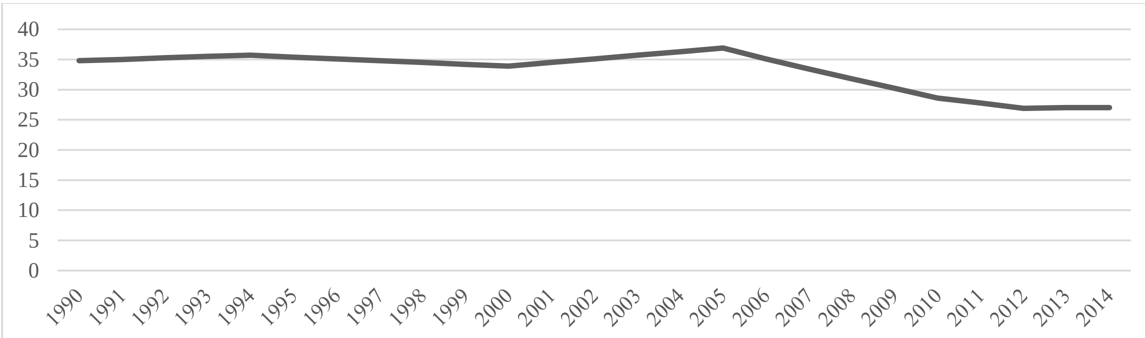
3.2.2. Indian context

Female labour market participation rate in India has been at 37% in 2005 and it has continued to decline gradually thereafter, remaining close to 25% in 2011-12 (see Figure 3.1). The 2011 IHDS dataset also reveals that female labour market participation rate is 25% (see Table 3.2) while the the average number of surviving children per woman during 2011-12 has been four. These children were born during the 1990s, when the live birth per woman was 3.8 (see Appendix Table A2.3). These estimates provide a scope for further investigation into the research question: whether a large number of children per woman, during 2011-12, have negative impacts on female labour market outcomes, particularly in presence of least one child, who is below the age of six.[26,27]

[26]Note that although both the fertility rate and female labour market participation rate have declined in the recent years, the presence of young children (although in the short-run) is likely to have negative impacts on female labour market outcomes.

[27]In Section 3.3.2, I graphically demonstrate how a woman's time-allocation may change due a new-born child (see Figure 3.5)

Figure 3.1: Female labour force participation rate (as % of female population, ages 15+)



Source: World Bank (2019). Refer to Appendix Table A3.25 for age wise statistics on female labour market participation since 1987.

The declining rate of female labour market participation is not only evident in urban areas (Klasen and Pieters, 2015) but also in rural areas (Afridi et al., 2018). According to Afridi et al. (2018), the increasing educational attainments among India's rural married women and men is the most prominent attribute contributing to this decline. This is because educated women choose to invest more time at home on children's education and health. In addition, with the rise in women's education, their reservation wages are likely to be higher. With the rise in their reservation wages, if women do not find suitable jobs, they prefer to stay at home and contribute to home production. Similarly, Klasen and Pieters (2015) underscore that a slow rate of sectoral expansion in urban areas in the face of the rising rate of educational attainments among both men and women and rising household income are primary factors contributing to the decline in female labour market participation in India. Eswaran et al. (2013) emphasise the fact that time allocation of women to market-work is primarily mediated through a family's desire to maintain economic-status. Women belonging to disadvantaged communities participate in the labour market because of the need to augment their economic-status by contributing to family income. When the families become economically better-off, these women exit the labour market and contribute to family-status production through contributing towards household chores and establishing good network with the neighbours. Therefore, female labour market participation decisions are determined by educational attainments of both men and women and family incomes.

Although unearned family wealth has been used in the earlier studies as a determinant of female labour market participation, the impact of wage rates on female labour market outcomes have never been explicitly studied before, which is included in this study.

Related studies in the past have also looked at the possible association between fertility and female labour market participation. For example, Das and Desai (2003), Klasen and Pieters (2015), Afridi et al. (2018) find that fertility (i.e., children below the age of six) has a negative association with female labour market participation, although Eswaran et al. (2013) observes no correlation. In contrast, school-aged children (i.e., between the ages of 6–15) have a positive association with female labour market participation. Recently, Sarkar et al. (2019) have studied Indian female employment transitions using panel data for two years period. One of the determinants of female employment transitions has been the number of children. Using IHDS datasets for 2005 and 2011, they also find a contrasting association between young children (under the age of six) and school-aged children (between the ages of 7 and 12) on female entry and exit from the labour market. They observe that an additional young child increases the chance of a woman exiting from the labour market, whereas the impact of a school-aged child is the reverse. However, the study has acknowledged that these effects are not causal, which requires further investigation.

3.2.3. Contribution

This study makes *four* novel contributions to the existing literature in the Indian context. *First*, I have redefined a woman's equilibrium allocation of time between house-work, market-work and leisure by introducing an additional constraint (i.e., *compulsory house-work time requirement*) into the Gronau model. *Second*, this is the first study in India that examines the causal impact of fertility on female labour market outcomes. To achieve this, I use two instruments for fertility: *twins* (i.e., whether or not a mother has twin children), following

Bronars and Grogger (1994) and *first-born girl* (i.e., whether or not the first-born child is a girl). *Third*, while all the earlier studies in the Indian context have focused mainly on female labour market participation, I have focused on both female participation and hours of labour supply in the market. *Finally*, I examine the impact of hourly wage on female labour market outcomes, which has not been explicitly studied earlier in the Indian context.

3.3. Theoretical model

In this section, I present the theoretical structure of female time allocation into three broad activities: housework, market-work and leisure. This allocation of time is known as the *trichotomy of time allocation* and can be formalised using a utility maximisation framework following Gronau (1977).

3.3.1. Gronau (1977): Trichotomy of time allocation

In the original Gronau framework, a woman derives her utility from her household's total consumption of goods and services as well as from her own leisure consumption. Her utility function may be written as:

$$U = U(X, L), \tag{3.1}$$

where X is the total amount of goods and services consumed by all her household members, and L is the total amount of leisure time consumed by the woman. For simplicity, I assume that the woman has homothetic preferences over X and L.[28]

Goods and services, i.e., X are either purchased from the market (denoted by X_M) or produced at home (denoted by X_H). Therefore, the allocation of total goods and services can be

[28]This implies a woman's utility increases (decreases) monotonically with the increase (decrease) in the unearned income or wage, with the prices of X and L remaining unchanged. Therefore, the expansion path is a straight line from the origin.

expressed by the following equation,

$$X = X_M + X_H. \tag{3.2}$$

Gronau implicitly assumes that X_M and X_H are perfect substitutes.

Let the time devoted by the woman for the home-good production be H, such that

$$X_H = f(H); f_H > 0, f_{HH} < 0. \tag{3.3}$$

The home-goods production is subject to diminishing marginal productivity, therefore $f_{HH} < 0$.[29]

The woman's incentive for market participation is determined by an exogenously given wage rate (W). In other words, when the market wage rate is sufficiently large relative to the woman's marginal productivity (f_H) at home, she will have an incentive to participate in the market.

The woman maximises her utility (U) subject to two constraints, a time-constraint and a budget-constraint. Her budget-constraint is given by,

$$X_M = WN + V, \tag{3.4}$$

where W is a given market wage rate, N is the amount of time that the woman spends in the market, and V is her unearned income (i.e., property or spouse's income). Her time-constraint is given by,

$$T = L + H + N, \tag{3.5}$$

where T is the fixed time, H is the amount of time for home-goods production, N is the

[29]The diminishing marginal productivity at home is exhibited after a certain point of total production due to fatigue.

amount of time for market-goods production, and L is the amount of time allocated to leisure activities.

To maximise the woman's utility subject to her budget constraint and her time constraint, the Lagrangian function ($\mathcal{L}$) is defined by,

$$\mathcal{L} = U\{X_M + f(H), L\} + \lambda(WN + V - X_M) + \mu(T - L - H - N), \tag{3.6}$$

where λ and μ are Lagrange multipliers, such that λ is the marginal utility of income and μ is the marginal utility of time. The Gronau-equilibrium condition is derived in Appendix A3.23.

Whenever the woman's imputed value of time in home-production is more than the market wage rate (W), she does not participate in the market and produces solely at home. The imputed value of time spent by the woman in home-production (in real terms) is her marginal productivity of home-production and is known as the *shadow price of time*. Suppose, the *shadow price of time* for home-production is W^*, such that $f_H = W^*$. Therefore, the equilibrium condition for home-based production can be written as:

$$MRS_{X,L} = f_H = W^*, \tag{3.7}$$

where $MRS_{X,L}$ is the marginal rate of substitution between X and L.[30] When a given wage rate is greater than marginal productivity of the woman at home (i.e., $W > f_H$), the woman has an incentive to participate in the labour market. The market-equilibrium condition that determines the optimal allocation of time into leisure, market-work and home-work and is given by the following expression (refer to Appendix A3.23, Equations A3.6 to A3.7),

$$MRS_{X,L} = f_H(= W^*) = W. \tag{3.8}$$

[30]Refer to Appendix A3.23, Equations A3.5 and A3.6

Equations 3.7 and 3.8 are the Gronau-equilibrium conditions for the home-based production (without market participation) and the market-based production respectively.[31]

Graphical illustrations of Gronau-equilibrium

Figure 3.2 graphically illustrates the home-based and the market-based optimal solutions as obtained from Equations 3.7 and 3.8. A woman's preference for X and L is represented by an indifference curve U_0. Her home-production function is given by be_0E_0t. The indifference curve is tangent to the home-production function at e_0. The slope of the production function at e_0 is the *shadow price* of home production W^*. Given a woman's preference and her home-production function, B_0e_0 is the total optimal consumption of goods, and OB_0 is her optimal amount of time for leisure consumption (denoted by L_0^*). The woman produces a_0e_0 amount of the goods (denoted by X_H^0) at home using the amount B_0t of time (denoted by H_0^*). The amount of market-goods consumed is B_0a_0 (denoted by X_M^0), which is purchased from the market using the unearned family wealth. The slope of the budget line is given by the market wage rate, W.[32]

Whenever the market wage rate is greater than the *shadow price* for home production, she will have an incentive to participate in the market. Consider a market wage rate of $W = W_1$. Clearly, $W_1 > W^*$. By participating in the market, she can enjoy higher utility at e_1, with higher amount of goods consumption as well as a higher amount of leisure.

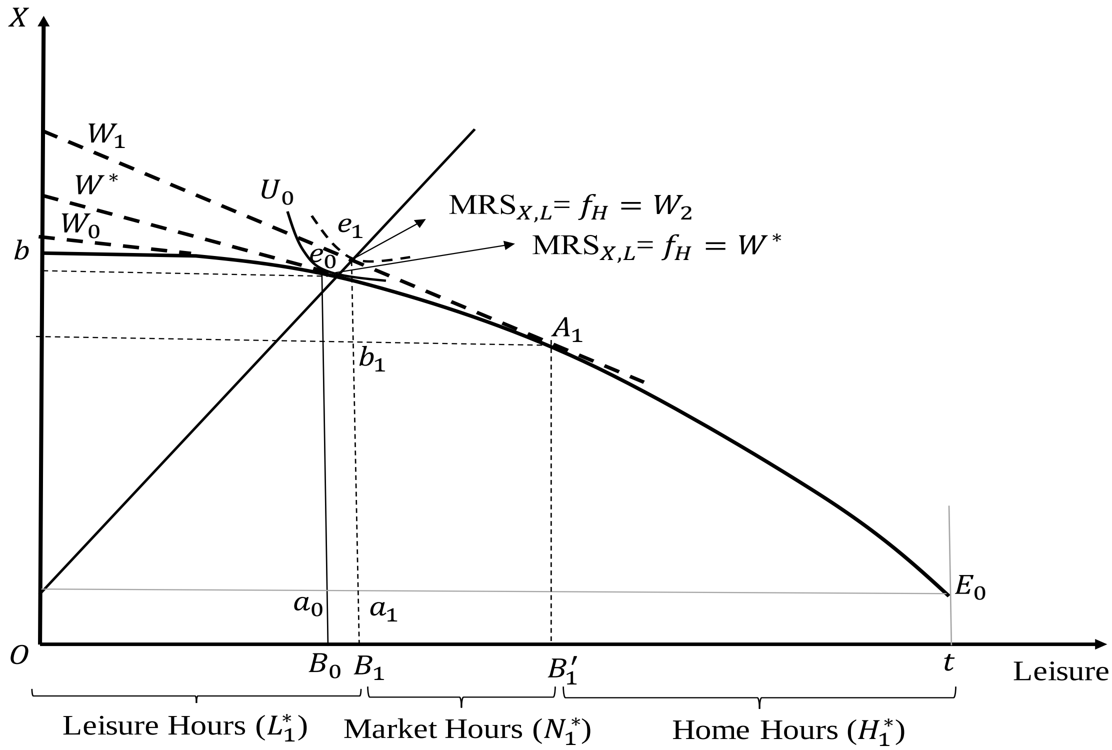
At e_1 her household will consume a_1b_1 amount of home-goods (denoted by X_H^1), which is produced by using $B_1^{'}t$ amount of her time (denoted by H_1^*), and $B_1a_1 + b_1e_1$ amount of market-goods (denoted by X_M^1 and it is to be noted that $X_M^1 > X_M^0$). To produce X_M^1 amount of market-goods, the woman spends $B_1B_1^{'}$ amount of her time in market activity (denoted by N_1^* where $N_1^* > 0$). The remaining OB_1 amount of time is consumed by her

[31]The second order conditions for the Gronau optimal solution are also presented in Appendix A3.24.

[32]When the wage rate is below the reservation wage W^*, the woman will not have any incentive to participate in the market and she will allocate her total time into home-time and leisure. Her home-time and leisure-time allocation will be determined at the point e_0 where her utility function is tangent to home production function, given her homothetic preference.

as leisure (denoted by L_1^*). Clearly, when the wage rate provides an incentive for the woman to participate in the market, the amount of leisure-time and market-time increases while the amount of home-time decreases (i.e., $L_1^* > L_0^*$, $N_1^* > N_0^*$ and $H_1^* < H_0^*$).

Figure 3.2: Gronau optimal solutions



Source: Author's own presentation.

3.3.2. Effect of compulsory housework time on optimal time allocation: Revised Gronau-equilibrium

In the Gronau framework, goods produced at home and those produced at market are assumed to be perfect substitutes. Therefore, with a reasonably high market wage rate, it is possible for a woman to replace her entire time for housework with market-work. In other words, the optimal amount of housework time can be equal to *zero*. This possibility, however, may not appear to be reasonable in practice and particularly in a developing country context where inflexible schedules at home, especially for women with young children, compel them to reserve a certain amount of time for household chores.[33]

In this paper I assume that a woman spends a minimum amount of compulsory time at home, which I refer to as the *compulsory housework time* (denoted by $\bar{H}$). This is devoted by a woman to compulsory household chores, including inflexible child-related activities for existing dependent children. Total housework time H, therefore, consists of the *compulsory housework time* $\bar{H}$ and any other additional (flexible) time spent on housework (H_H), i.e., $H = \bar{H} + H_H$ where $\bar{H} > 0$ and $H_H \geq 0$. This means that, even though H_H may be equal to *zero*, $\bar{H}$ can never be equal to *zero*. This is the amendment made into the original Gronau framework. The time-constraint in Equation 3.5 may then be revised as

$$T - \bar{H} = L + H_H + N. \tag{3.9}$$

The incorporation of this additional *compulsory time constraint* ($\bar{H}$) contributes to the understanding of how the optimal time allocation deviates from that of the Gronau-optimal time allocation. Unlike in the Gronau framework, where a woman returns to a job to buy child-related goods when home-time becomes expensive after a certain period of time, my model explains the alternative possibility that a working woman may quit her job in order to undertake responsibilities for a new-born child.

Given that I aim to focus on women who are already participating in the labour market, for the remaining analysis I assume that the given market wage is $W = W_1$ so that $W > W^*$. To keep the model simple, I assume $H_H = 0$.

When the *compulsory housework time* $\bar{H}$ is less than or equal to the optimal housework time H_1^* (i.e., $\bar{H} \leq H_1^*$), the optimal allocation of time is identical to the Gronau framework where $H_1^* = \bar{H}$ (refer to Figure 3.2).

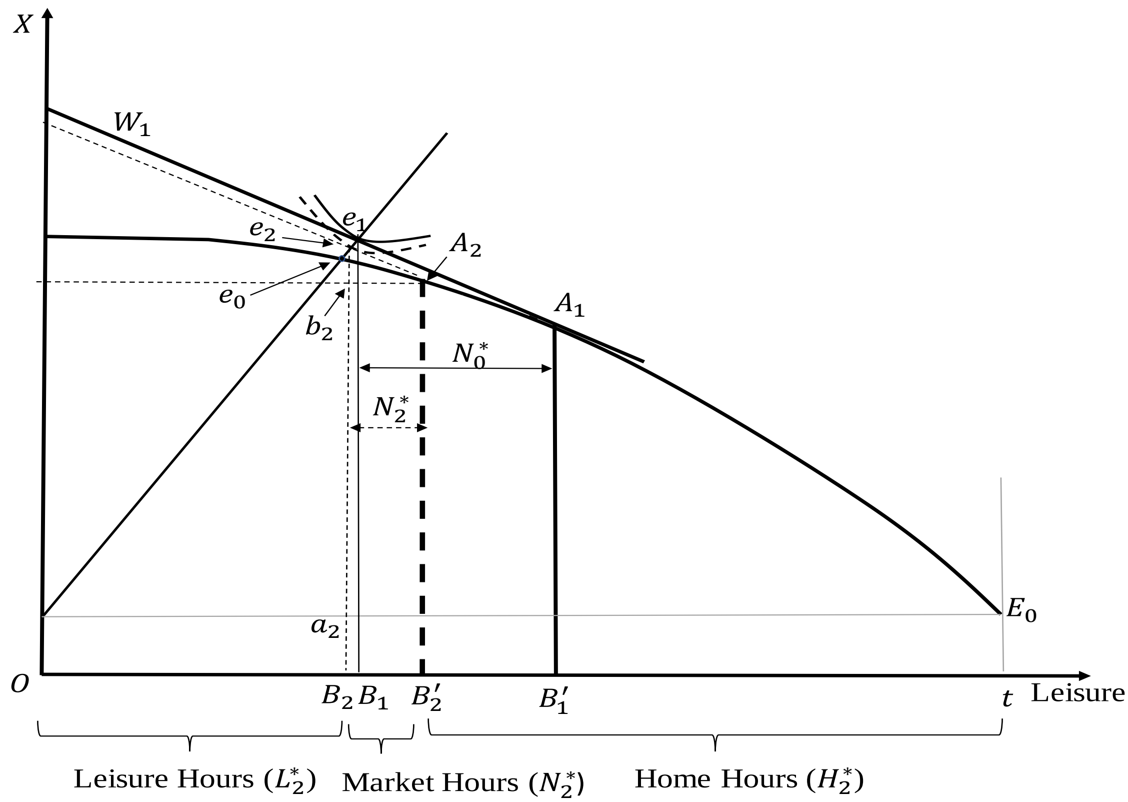
[33] This inflexible nature of work at home is also true for a developed country context. See Smith-Lovin and Tickamyer (1978) in the context of the USA.

The optimal time allocation, however, departs from the Gronau framework when the *compulsory housework time* $\bar{H}$ is larger than the optimal housework time H_1^* (i.e., $\bar{H} > H_1^*$) with two possibilities: (I) $H_0^* > \bar{H} > H_1^*$ and (II) and $\bar{H} > H_0^*$.[34] I illustrate these cases using Figures 3.3 and 3.4 below.

In Case I: when $H_0^* > \bar{H} > H_1^*$ (refer to Figure 3.3 below; $\bar{H} = B_2^{'}t$, determined by the hatched vertical line), a woman produces a_2b_2 amount of goods at home using the optimal amount of time $B_2^{'}t$. The increase in home-time ($\bar{H} > H_1^*$), primarily due to certain additional household chores, reduces her time available for market-work. Therefore, she earns a lower market wage reflected by the parallel shift in the market wage line downwards (denoted by the dotted straight line) as the wage rate remains the same. She produces b_2e_2 amount of goods in the market using $B_2B_2^{'}$ amount of time (denoted by N_2^*), while her household consumes market goods of the amount $b_2e_2 + B_2a_2$ (denoted by X_M^2 which is less than X_M^1 but greater than X_M^0, see Figure 3.2). The remaining amount of time OB_2 is consumed in leisure (denoted by L_2^* which is less than L_1^* but greater than L_0^*, see Figure 3.2). Her utility at e_2 is higher than that at e_0 (original home-based equilibrium) and so she continues to participate in the market.

[34]Recall from the Gronau framework (refer to Figure 3.2) that the optimal time allocated to housework is H_1^* when the market wage $W(= W_1) > W^*$. Likewise, the optimal time allocated to housework is H_0^* when the market wage is equal to the shadow price, i.e., $W = W^*$ and $H_0^* > H_1^*$.

Figure 3.3: Optimal time allocation with compulsory housework time ($H_0^* > \bar{H} > H_1^*$)

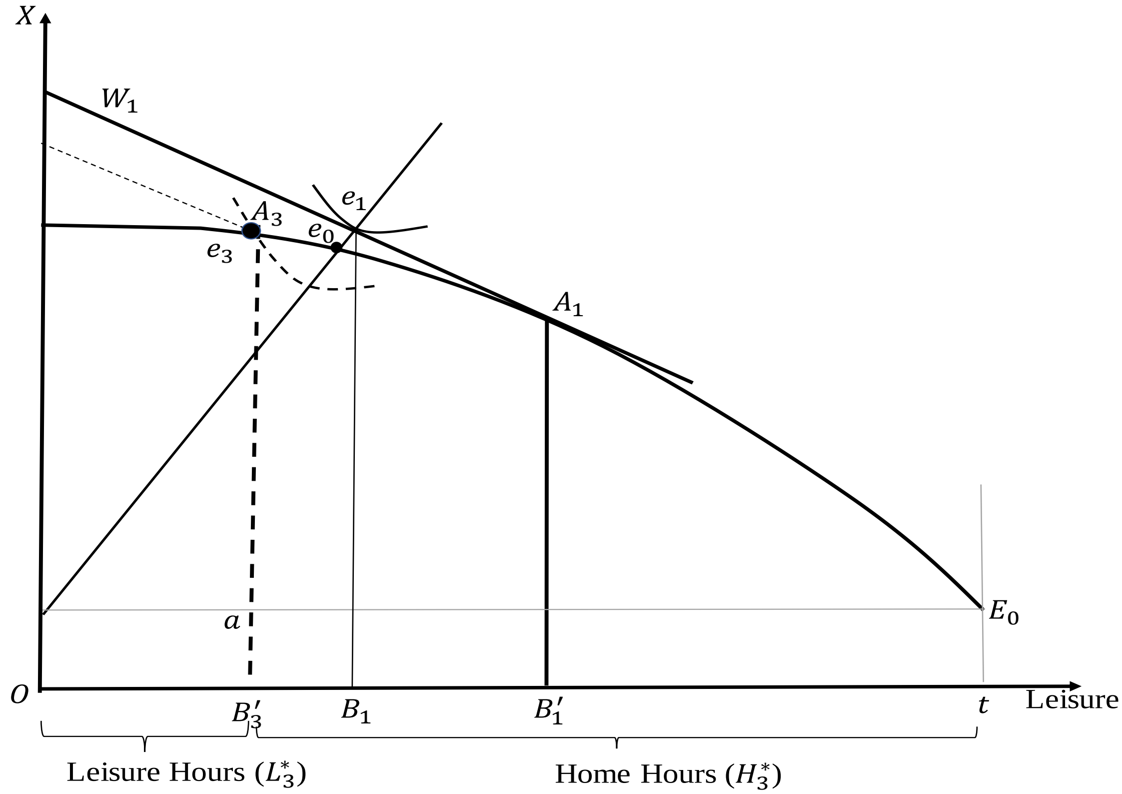


Source: Author's own presentation.

In Case II: when $\bar{H} > H_0^*$ (refer to Figure 3.4 below; $\bar{H} = B_3^{'}t$, determined by the vertical hatched line), a woman produces ae_3 amount of goods at home using $B_3^{'}t$ amount of time. I denote this optimal amount of time spent on housework ($B_3^{'}t$) by H_3^*. At the given wage rate W_1 and the *compulsory hours of housework* (H_3^*), if she continues to participate in the market then she will obtain lower utility at e_3 than at e_0 (original home-based equilibrium). In other words, to the left of point e_0, at the given wage rate, the decrease in her leisure to compensate for the increase in the production of market-goods will be so expensive that it will compel her to exit the market and continue to produce at home at e_0.[35]

[35]Note that e_3 in Figure 3.4 is a *sub-optimal* point (neither the utility curve is tangent to the production function at this point nor is it a point on the woman's homothetic preference line). Therefore, the woman will never choose to produce at this point.

Figure 3.4: Optimal time allocation with compulsory housework time ($\bar{H} > H_0^*$)



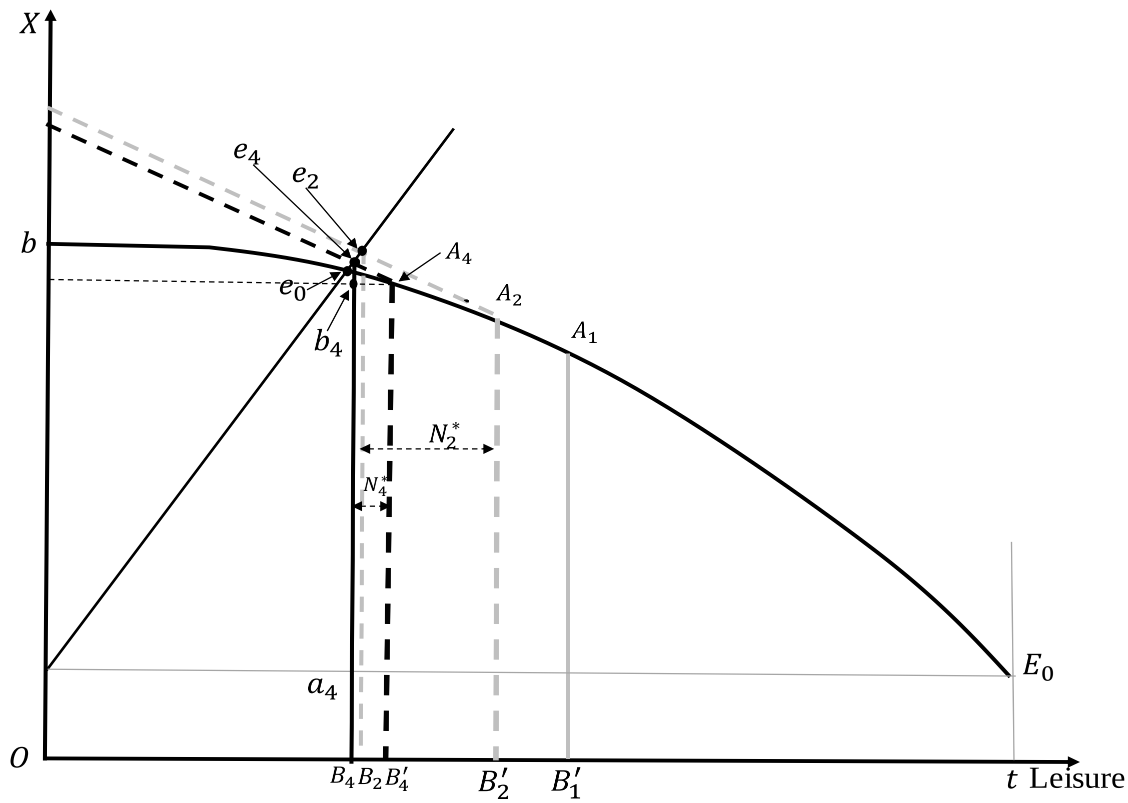
Source: Author's own presentation.

The above graphical illustrations portray how the magnitude of change in $\bar{H}$ can have an impact on the allocation of time as well as on female labour market participation. There could be several causes behind this change in $\bar{H}$. One of these causes could be the arrival of a new-born child in a family, bringing some additional responsibilities and therefore increasing the *compulsory housework time* to $\bar{H}'$ such that $\bar{H}' > \bar{H}$. There could be two possible cases as discussed before: (I) $H_0^* > \bar{H}' > \bar{H} > H_1^*$ and (II) $\bar{H}' > H_0^*$.

In Figure 3.5, when $H_0^* > \bar{H}' > \bar{H} > H_1^*$ a woman produces $a_4 b_4$ amount of goods at home using $B_4^{'}t$ amount of time. This further increases home-time, primarily due to additional childcare time requirements, further reducing her time available for market-work ($N_4^* < N_2^*$) and leisure ($L_4^* < L_2^*$). The intuitive reasons behind the decline in L and N due to the increase in $\bar{H}$ (such that $\bar{H}^{'} > \bar{H}$) is discussed in Appendix A3.51.

Similarly, when the increase in the compulsory housework time is higher than the optimal amount of home time (at e_0) such that $\bar{H}' > H_0^*$, the woman will exit the labour market (i.e., this case is similar to Figure 3.4 above).

Figure 3.5: Illustration of allocation of time with new-born children ($H_0^* > \bar{H}' > \bar{H} > H_1^*$)



Source: Author's own presentation.

Therefore, the incorporation of $\bar{H}'$ as an additional constraint in the Gronau model can lead to two possible solutions: optimal solution at e_4 (in Figure 3.5, where a working woman continues to participate in the labour market), and *sub-optimal* solution at e_3 (in Figure 3.4 where a working woman exits the labour market).

In the above theoretical framework, the shifts in the $\bar{H}$ can be explained by a fertility shock. I am going to use this theoretical framework to situate my empirical analysis. In particular, I examine the impact of an exogenous change in female fertility on female labour market outcomes. In doing so, I exploit two instruments for the fertility variable, namely, *twins* and *first-born girl*. The instruments are used to control for the endogeneity in the fertility variable. In this analysis, the fertility variable comprises of two age groups of children: young children, below 6 years of age and school-aged children between the ages of 6–17.

3.4. Data and descriptive statistics

The Human Development Survey (IHDS) is considered more suitable for this study than the National Family Health Survey (NFHS) because the latter does not have information on wages or salaries. In contrast, the IHDS survey comprises of information on socio-economic conditions of households including educational status, employment, income, consumption expenditure and social capital. The survey covers all 28 states and 5 union territories of India, but excludes the 2 union territories of the Andaman and Nicobar Islands and Lakshadweep. I use the latest 2011 Human Development Survey dataset (IHDS-II) in this study to capture the latest information on the *fertility* of the women.

The sample comprises 15,790 women aged between 18 and 62 years. I consider two separate non-overlapping independent female sub-samples with dependent children: one sample is comprised of women who are aged between 18–54 and have only young children (below the age of 6); the other sample is comprised of women who are aged between 18–62 and have school-aged children (between the ages of 6–17). There are 6,277 women having solely young children and 9,513 women having solely school-aged children.[36] All the eligible women have at least one child.[37] *Twin births* are identified using the month and year of birth of the children. Only 1.09% of mothers have twin children in the whole sample (0.86% in the sample of women with young children, 1.24% in the sample of women with school-aged children). In contrast, 46% of the mothers have a *first-born girl* in the whole sample (48% in the sample of women with young children, 45% in the sample of women with school-aged

[36] I do not consider the sample of women who have a combination of both young and school-aged children as this sample of women may pick up a different and contaminated fertility effect of all types of children.
[37] IHDS has interviewed all eligible women who are aged 15 or above.

children).

Table 3.1: Descriptive statistics of the IHDS-II women sample

Mother & household characteristics	All mothers	Mother with twins (1)	Mother without twins (2)	Mean difference (1)-(2)	
No. of children	1.87	2.93	1.86	1.07	(0.00)
Regional wage rate	18.87	19.33	18.87	0.46	(0.36)
Land ownership (0/1)	0.45	0.39	0.45	-0.06	(0.10)
Age of mother	31.51	33.45	31.49	1.97	(0.00)
Age at marriage	18.59	18.93	18.58	0.35	(0.28)
Married	0.97	0.97	0.97	-0.00	(0.94)
Widowed & divorced	0.03	0.03	0.03	0.00	(0.94)
No education	0.29	0.30	0.29	0.01	(0.82)
Primary	0.15	0.12	0.15	-0.03	(0.24)
Secondary	0.37	0.35	0.37	-0.02	(0.61)
Post sec. education	0.10	0.13	0.10	0.02	(0.36)
Graduate education	0.08	0.10	0.08	0.02	(0.45)
OBC	0.35	0.31	0.35	-0.04	(0.26)
Hindu Brahmin	0.05	0.06	0.05	0.01	(0.56)
Hindu Forward	0.18	0.21	0.18	0.03	(0.31)
SC and ST	0.29	0.26	0.29	-0.03	(0.45)
Muslim	0.11	0.12	0.11	0.01	(0.68)
Christian and others	0.03	0.04	0.03	0.01	(0.41)
Urban	0.34	0.35	0.34	0.01	(0.77)
Childhood in urban	0.19	0.22	0.19	0.03	(0.28)
Market participation rate	0.25	0.27	0.25	0.02	(0.66)
Market work hours	332.16	350.05	331.96	18.08	(0.75)
Observations	15,790	172	15,618	15,790	

Notes: Figures in parentheses are p-values. The overall share of women who are doing part-time jobs is 77%. Part-time work included: 240-1,984 hours. Full-time work includes 2,000-4,000 hours. Only 0.2% of participating women have reported that they have worked for 4,000 hours on an annual basis.
Source: Estimates are based on author's own calculation using the IHDS-II dataset.

Almost all the women (i.e., 97%) are married, while 3% are either divorced or widowed (see Table 3.1). The average age of women is 31.5 years. Thirty-five percent of the women belong to households who are from Other Backward Classes (OBC), 5% are Brahmins, 18% belong to Forward class, 29% of the women are Scheduled Castes (SC) and Scheduled Tribes (ST) members, 11% are Muslims and the remaining 3% of the women are Christian, Buddhist, Jain, Sikh and from other religion. The majority of women (i.e., 66%) reside in rural areas.

Almost half the women in the sample own lands as property, and the average regional hourly wage is 18 rupees.[38] A quarter of women participate in the labour market, of which 77% have part-time jobs with annual hours of work ranging between 240 and 1,990 hours, while 23% of women have full-time jobs with annual hours of work ranging between 2,000 and 4,000 hours.[39]

Table 3.2 reveals that out of the 3,987 working women, 48% work in the agricultural sector (60% of rural women are agricultural workers, while only 11% are such workers in urban areas). The remaining employment sectors in which the working women are engaged include business, official (i.e., formal), manufacturing and other menial work. Although the majority of the working women are engaged in the agricultural sector in rural areas, the average annual working hour is highest in the official (i.e., formal) sector. In urban areas, the majority of the working women are engaged in the official (i.e., formal) sector, where the average annual working hour is found to be the highest (i.e., 2,150 annual hours).

[38] The country is segmented into five regions, namely Northern, North eastern, Central, Eastern, Western and Southern.

[39] In the IHDS-II women sample, 8 out of 3,987 (i.e., 0.2%) participating women have reported that they have worked for 4,000 hours or more on an annual basis. Hence, in the dataset, the reported 4,000 or more hours are capped to 4,000 hours. Further information on average hours worked per week by female workers as self-employees, regular wage or salaried employees and casual labours are available from GOI (2019) (refer to Statement 26, p. 77). Considering all economic activities, the statistics show that the average number of hours worked in a week for regular wage or salaried female employees (casual female labour) is 50 (39) in rural areas and 52.6 (42) in urban areas.

Table 3.2: Descriptive statistics of the IHDS-II women's employment sectors

Employment sector	Overall share of women(%)	Urban: share of women (%)	Rural: share of women (%)	Overall annual hours	Urban: annual hours	Rural: annual hours
Participation Rate	25.25	17.03	29.56			
Agriculture	48.33	11.03	59.60	1046.02	1281.71	1032.85
Business	18.69	12.32	20.61	976.41	1680.03	849.29
Official	14.85	32.43	9.54	2109.44	2149.99	2067.77
Manufacturing	9.73	19.35	6.83	1646.64	1781.02	1531.55
Other	8.40	24.86	3.43	1832.87	1888.93	1710.08
Total (%)	100.00	100.00	100.00	1315.48	1860.01	1150.98
Total participation	3,987	925	3,062	3,987	925	3,062
Total by area	15,790	5,430	10,360	15,790	5,430	10,360

Notes: Participation rate is calculated by total number of women participating in the labour market divided by total number of women in the sample.
Further statistics on percentage distribution of female workers in usual status and subsidiary status by broad industry division from 1997–78 to 2017–18 are available from GOI (2019) (refer to Statement 16 in the report).
Source: Estimates are based on author's own calculation using the IHDS-II dataset.

3.4.1. Dependent variable

Female labour market participation is a binary variable denoted by LFP_i for the i^{th} woman:

$$FLP_i = \begin{pmatrix} 1 & \text{if women in paid work in the last 12 months} \\ 0 & \text{if women not in paid work in the last 12 months} \end{pmatrix}$$

In this study I consider women who are working in paid jobs outside home. It is not feasible to provide empirical insights of what unpaid work the women routinely do at home in family enterprises (such as livestock or poultry farming, fishing, supplying production in neighbourhood grocery stores, making small items for sale, growing fruit and vegetables for sale etc.) because of limited information in the dataset. Hence, I have kept the model simple to enable testing its predictions using the available data on paid work of the women.

The annual hours of market-work are the number of hours of paid work undertaken by women in the labour market in the last 12 months.

3.4.2. Explanatory variables

The primary explanatory variable, i.e., fertility, is measured by the number of children born and currently residing with the women. I categorise the sample of women into two groups: women who have children below the age of 6 (defined as young children), and the sample of women who have children between the ages of 6 to 17 (defined as school-aged children).

The economic determinants of labour market outcomes are wage rate and family wealth. The average regional hourly wage earned by the women is calculated as follows: India is broadly divided into six regions: northern, north-eastern, central, eastern, western and southern. The hourly wage is averaged by the wage rate prevailing in these regions. I use the natural logarithm of the regional wage rates in the empirical analysis. The regional wage rates are considered exogenous, but it is acknowledged that there is limited variation in the empirical values within the measure.

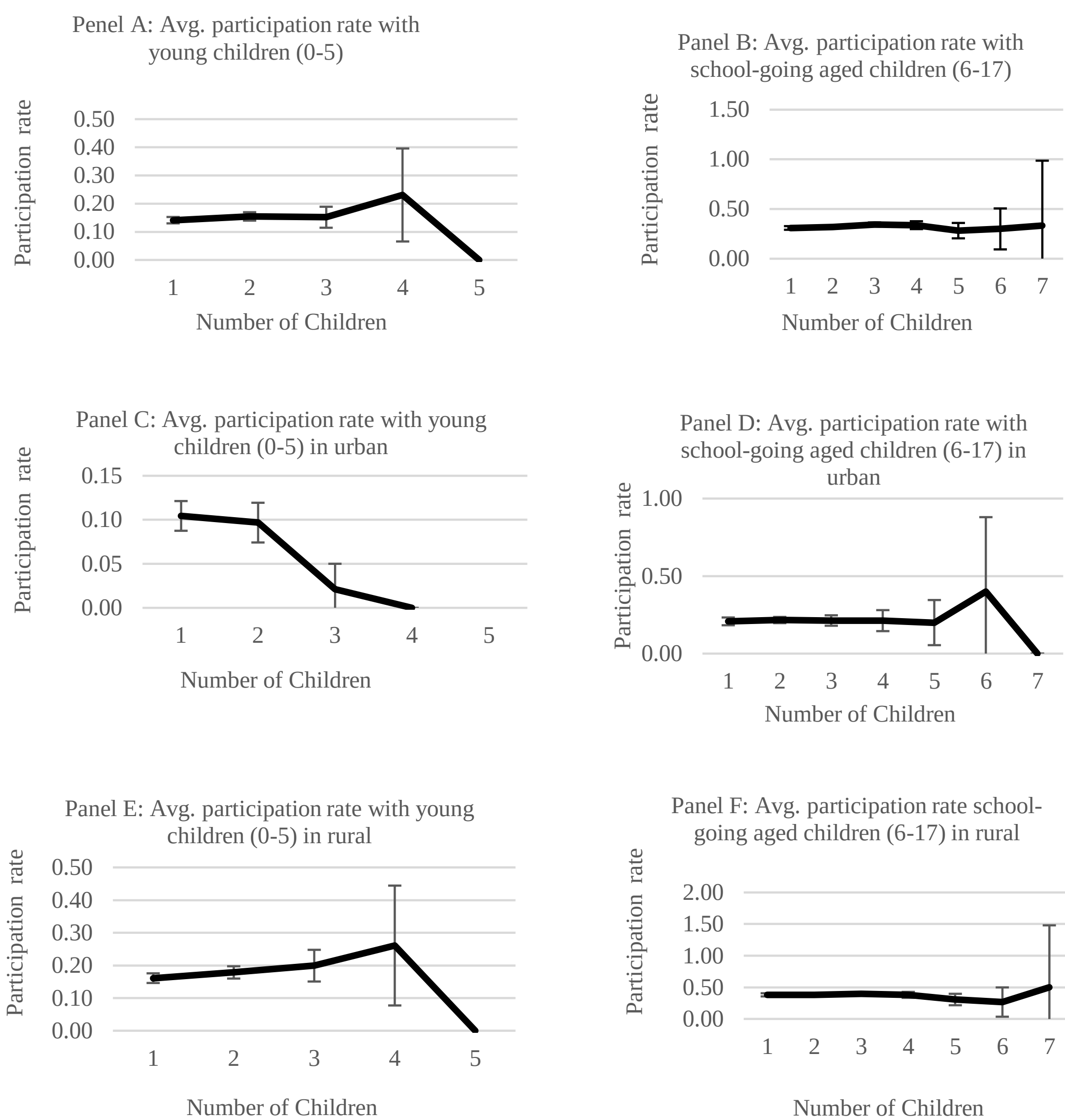
Land ownership by the households is considered as a proxy measure for family wealth. There are two reasons behind considering land ownership as the wealth measure. *First*, there are limited data on husbands' incomes. *Second*, more than 60% of the women are from rural households and hold property in the form of land.

The demographic variables comprising of women and household specific characteristics (denoted by X_{1i}) include the age at marriage, the current age of the women, marital status, urban place of residence, urban childhood place of residence, educational attainment (completed primary, secondary, post-secondary or graduation; no education is considered as the base category), caste (Brahmin, Forward Class, Scheduled Castes, Scheduled Tribes, OBC, Muslim, Christians and other). The states of India are categorised into six regions: Northern, North-Eastern, Central, Eastern, Western and Southern, the latter of which is considered as base category in the regression analysis.

3.4.3. Empirical relationship between fertility and female labour market outcomes

The empirical relationship between the number of children and female labour market outcomes are presented in Figures 3.6 and 3.7 below.

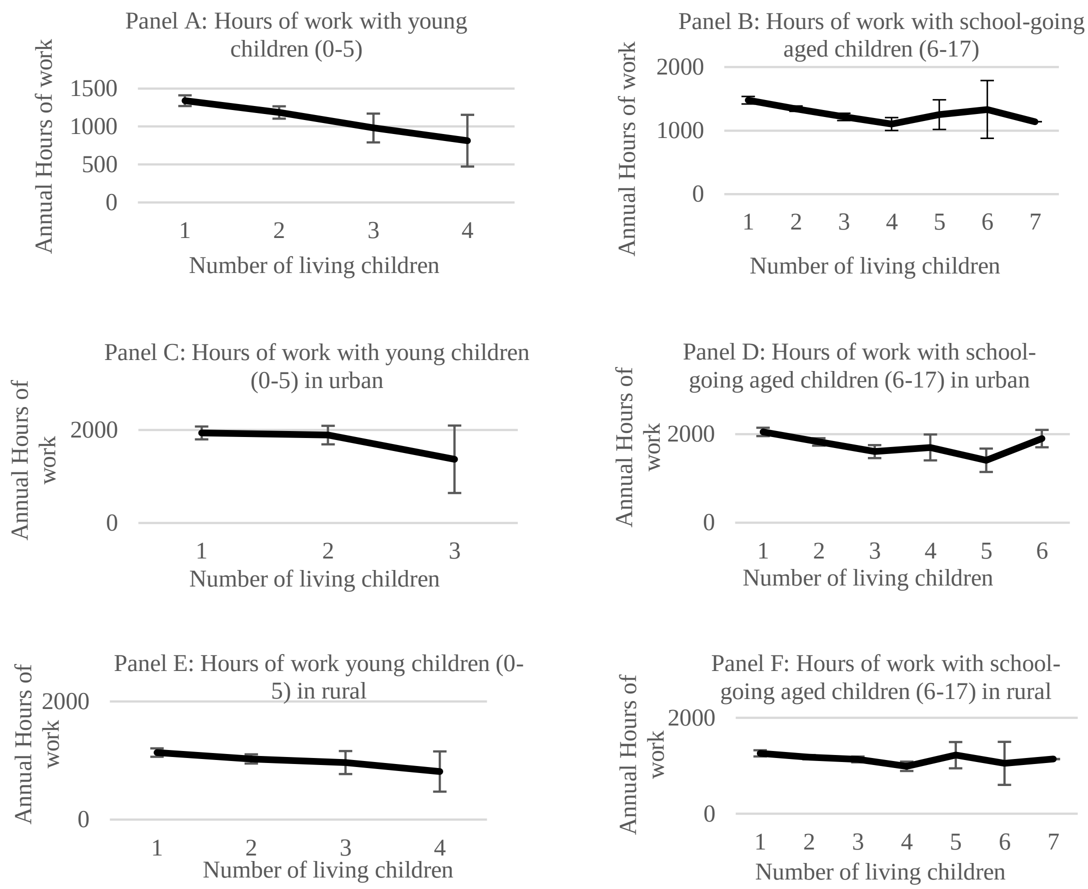
Figure 3.6: Empirical relationship between fertility and the IHDS-II women's participation rate



Source: Estimates are based on author's own calculation.

The vertical bars represent the 95% confidence intervals. The graphs depict the empirical relationship between fertility and female labour market participation; this is negative for those women who have only young children, especially in urban India (see Figure 3.6, Panel C). The participation rate among rural women rises with the increase in the number of young children, but it drastically declines for women who have more than four young children (see Figure 3.6, Panel E). For the overall sample of women who have only school-aged children, the participation rate remains between 20-40% (see Figure 3.6, Panel B). The participation rate remains stable around 25% for urban women with school-aged children (see Figure 3.6, Panel D), and it is independent of the number of school-aged children. However, for rural women the participation rate remains higher than for urban women and remains more or less stable but slightly below 50% (see Figure 3.6, Panel F).

Figure 3.7: Empirical relationship between fertility and the IHDS-II women's average annual hours of labour supply



Source: Estimates based on author's own calculations.

The vertical bars again represent the 95% confidence intervals. The graphs show that the relationship between fertility and average annual hours of labour supply by women is negative for the sample of women who have young children in both urban and in rural areas (see Figure 3.7, Panels A, C and E respectively). For women with 4 young children, the average annual hours of labour supply in the market is less than 1,000 hours (see Figure 3.7, Panel A), whereas it never falls below 1,000 hours for women with school-aged children (see Figure 3.7, Panel B). For the overall sample of women with school-aged children, annual hours of labour supply keep declining below 1,500 hours with each additional child (see Figure 3.7, Panel B). Compared to the sample of women with young children, the average annual hours of labour supply for women having school-aged children remains higher in both urban and rural areas (see Figure 3.7, comparing Panel C with Panel D; Panel E with Panel F).

In summary, Figures 3.6 and 3.7 reveal that the relationships between fertility and women's labour market outcomes are negative for the sample of women with young children, which is prominently visible in urban areas.

3.5. Identification strategy

The primary variable of interest in this study is the number of children which is potentially endogenous with respect to the selected labour market outcomes (i.e., participation in the labour market and annual hours of labour supply in the market). This is because the unobserved individual preference may influence fertility as well as the selected outcomes. For example, the parental desire for having a male child can influence both fertility and labour market outcomes. This desire for having a son increases the family size and simultaneously reduces the likelihood of female participation in the labour market when the child is young. Without accounting for such unobserved parental choices, the estimated coefficient of fertility may be subjected to omitted variable bias.

On the other hand, the selected outcomes may also influence fertility decisions (Smith-Lovin and Tickamyer, 1978). For example, the poor economic condition of a family may necessitate a woman to participate in the labour market; in turn, this may compel a woman to choose a smaller number of children to facilitate her labour market participation. This is a case of reverse causality and, therefore, the estimated coefficient of fertility will be subjected to simultaneity bias.

Therefore, in order to examine the causal impact of fertility on female labour market outcomes, I exploit the exogenous variation in fertility using two separate instruments that are considered suitable in the Indian context, namely *twins* and *first-born girl*.

In the Indian context, *twins* can be considered as an exogenous instrument for two main reasons. *First*, the Pre-natal Diagnostic Technique Act (PNDT) has made foetal-sex detection illegal in India (Kumar and Kugler, 2017). *Second*, according to the medical literature, in vitro fertilisation can increase the chances of twin births. However, such a procedure is expensive and strictly unaffordable for the type of households in the sample where the major share of women are working in the agricultural sector, and the average hourly regional wage is 18 rupees.

However, the instrument may not be free of caveats. It is possible that twin births have an independent effect on women's health. In the IHDS-II survey dataset, there is a variable describing a woman's general health conditions across five criteria: 'very good', 'good', 'okay', 'poor' and 'very poor'. I have used this woman's general health information to test the proposition that twin births exert an independent effect on the health of a woman. I regress a woman's general health condition on twin births and a set of control variables that include: the number of children residing with mothers, regional wage, unearned income (land), age of women, square age of women, education of women, place of residence (urban or rural), caste, regions of India. The sample is comprised of women who are aged between 18-54 and only have young children (i.e., those are aged between the ages of 0-5). The estimated effect of twins on a woman's health outcomes is not found to be statistically significant (t-ratio = 1.1) suggesting the birth of twins does not adversely affect a mother's health.

In addition, the estimated effect of twins on female labour market participation and hours of labour supply is not found to be statistically significant for the entire sample (t-ratio = 0.14, 1.88 respectively) suggesting the birth of twins does not adversely affect a mother's labour supply outcomes directly.

In addition, it is acknowledged that the 'shock' of having twins may impose additional costs on households but these costs are unlikely to be alleviated by the mother participating or working longer hours in the labour market as suggested by this finding. The costs are more likely to be off-set by other members of the household participating in the labour market. However, this is a conjecture and cannot be formally tested but is clearly something that requires investigation as part of an agenda for future research.

The validity of the second instrument, i.e., the *first-born girl*, can be analysed as follows. Given the strong preference for sons among Indian parents, a woman with a *first-born girl* may prefer to have a male child. Hence, *first-born girl* is likely to increase the number of children for a woman. With regard to the orthogonality (i.e., exogeneity) of the instrument, however, there could be an issue with *first-born girl*. For example, mothers generally benefit from having a *first-born girl* because a girl is likely to take care of her younger siblings and several household chores thus, freeing their mothers for market work. However, the empirical findings do not support this hypothesis. Using the given sample under study, I find that the impact of *first-born girl* on women's labour market participation is statistically insignificant. This could be because freeing mothers to work outside home requires a girl to be at least a teenager if not an adult. Therefore, the gender of the first-born child can be considered as a valid instrument in the Indian context. Nevertheless, there could be an alternative issue with *first-born girl*. For example, having or not having a *first-born girl* could be influenced by unobservable parental preferences. Parents may choose to abort a girl child before the birth of the first child. Although such information is not available in the given dataset even then it can be argued, especially in the Indian context, that the Pre-natal Diagnostic Techniques act (PNDT) has made foetal-sex detection illegal in India (Kumar and Kugler, 2017); this makes abortion legally a difficult choice for Indian parents.[40]

The orthogonality condition for a set of instruments comprising of *twins* and *first-born girl* is tested using Hansen-J statistics. This is discussed in the results section.

[40] Abortion through illegal channels could prove costly for rural women who may be left with no choice but to give birth. However, after giving birth, there are potential possibilities that women may prefer giving away their girl children to those who want to adopt children through special organisations or hospitals. In the presence of such possibilities, the first-born girl may not be a valid instrument. In this analysis, I therefore assume that there are no such possibilities as these are beyond the scope of the current investigation.

To examine the causal impact of fertility on female labour market outcomes, the first stage regression equation for the number of children residing with the i^{th} woman can be expressed as,

$$C_i = \gamma_0 + \gamma_1 IV_i + \gamma_2 W_i + \mathbf{\Gamma X}_i' + \omega_i, \tag{3.10}$$

where $i = 1, 2, ..., n$; IV_i denotes the instrumental variables for fertility (i.e., *twins* and *first-born girl*) corresponding to the i^{th} woman. These instruments are dummy variables and are assigned a value of *one* if the respective event occurs, otherwise, a value of *zero* is assigned; W_i is the regional hourly wage. Vector X_i is the set of characteristics relating to the i^{th} woman and her household, and ω_i is the error term.

The primary equation of policy interest can be written as,

$$y_{ij} = \delta_0 + \delta_1 \hat{C}_i + \delta_2 W_i + \mathbf{\Delta X}_i' + \xi_{ij}, \tag{3.11}$$

where y_{ij} is the j^{th} labour market outcome for the i^{th} woman, $\hat{C}_i$ is predicted values for the number of children obtained from the first stage regression equation (Equation 3.10) and ξ_{ij} is the error term. Assuming that the orthogonality and the relevance conditions of the instruments are satisfied, the estimated coefficient δ_1 gives the causal impact of fertility on the selected outcomes.

3.6. Results

My empirical analysis is conditional on the two age-groups of children: 0–5 and 6–17. The focus on these two different age-groups provides a good opportunity of identifying the unambiguous effects on female labour market outcomes of fertility decisions. There is likely to be heterogeneity in the effects of fertility on labour market outcomes for these two groups. In particular, the 0–5 age-group is anticipated to give negative effects while the 6–17 age-group is likely to yield positive effects. By considering the two groups separately, it is possible to obtain unambiguous effects for these two heterogeneous groups.

In contrast, if one uses the whole age-group (i.e., those with children aged between 0–18 years) is not able to untangle these two unambiguous effects because there is a good chance that opposite effects may cancel each other.

This study primarily aims to examine whether having young children (school-aged children) has negative (positive) impacts on female labour market outcomes. The economic variables, such as wage rate and unearned family wealth, also feature as a key part of the theoretical framework. The wage rate captures the opportunity cost of engaging in domestic household production activity by the woman. Therefore, it is relevant to comment on the impact of the wage rate on female labour market outcomes, although it is acknowledged that the main focus of the research is on the fertility effect. In addition to these variables, I have also controlled for the demographic characteristics that are likely to influence female labour market outcomes.

The empirical results are presented in the following sub-section. The columns of the tables differ depending on the outcome variables and the econometric methodology used. In the second columns of the tables, I report the estimates using a linear probability model (LPM) for female labour market participation outcome, and in the third columns of the tables, I report the estimates using a ordinary least squares (OLS) method for women's annual hours of labour supply outcome. From the fourth to ninth columns, I report the estimates using an instrumental variable analysis (using the instruments: *twins*, *first girl* and the combination of both the instruments) for the two labour market outcomes.

3.6.1. Main results

Effect of young children on female labour market outcomes:

At first, I look at OLS results to examine the association between fertility and the female labour market outcomes. Table 3.3 reveals that, on average, an additional young child reduces the probability of female labour market participation by 1 percentage point while it reduces female labour supply by 25 hours annually on average. These results are statistically significant at the 10% and 5% levels respectively. These estimates reveal that there is a negative association between young children and female labour market outcomes.

Before examining the causal relationship between fertility and labour market outcome, let us look at the economic and demographic variables that are likely to influence the labour market outcomes.

Since wage rate plays a crucial role in influencing women's labour market participation decision, it becomes important to test its implications. The empirical results in Table 3.3 reveal that a 1% increase in the wage rate increases the chance of female labour market participation by 0.30 of a percentage point, and it increases the female labour supply by 5 hours on average annually. These results are statistically significant at 1% level. The results show that the wage rate meaningfully captures its positive impact on women's labour market outcomes, which is consistent with the developed country literature.

Table 3.3: 2SLS: Effect of young children on female labour market outcomes

Mother Age 18-54	LPM Part.	OLS Hours	2SLS Twins Part.	2SLS Twins Hours	2SLS FG Part.	2SLS FG Hours	2SLS Twins & FG Part.	2SLS Twins & FG Hours
Main variable:								
No. of children	-0.01*	-25.14**	-0.11***	-201.85***	-0.05	-94.09	-0.10***	-176.84***
	(0.01)	(11.02)	(0.03)	(29.74)	(0.08)	(128.43)	(0.03)	(37.57)
Economic variables:								
Log wage rate	0.30***	507.13***	0.31***	528.40***	0.30***	515.43***	0.31***	525.39***
	(0.09)	(132.75)	(0.09)	(134.40)	(0.09)	(133.98)	(0.09)	(134.00)
Land ownership (0/1)	-0.05***	-78.79***	-0.05***	-84.23***	-0.05***	-80.91***	-0.05***	-83.46***
	(0.01)	(16.24)	(0.01)	(16.56)	(0.01)	(16.62)	(0.01)	(16.46)
Demographic variables:								
Age at marriage	-0.01***	-5.23**	-0.01***	-14.36***	-0.01**	-8.80	-0.01***	-13.07***
	(0.00)	(2.60)	(0.00)	(3.00)	(0.00)	(7.08)	(0.00)	(3.20)
Age of mother	0.01	16.09	0.04***	63.41***	0.02	34.56	0.04***	56.72***
	(0.01)	(14.98)	(0.01)	(15.63)	(0.02)	(37.41)	(0.01)	(17.01)
Age mother square	-0.00	-0.06	-0.00**	-0.77***	-0.00	-0.34	-0.00**	-0.67**
	(0.00)	(0.28)	(0.00)	(0.28)	(0.00)	(0.59)	(0.00)	(0.30)
Married	-0.20***	-302.81***	-0.16***	-234.61***	-0.18***	-276.20***	-0.17***	-244.26***
	(0.05)	(86.15)	(0.05)	(87.03)	(0.06)	(96.06)	(0.05)	(86.54)
Urban	-0.08***	-59.46***	-0.09***	-67.56***	-0.08***	-62.62***	-0.09***	-66.42***
	(0.01)	(19.18)	(0.01)	(19.48)	(0.01)	(20.02)	(0.01)	(19.41)
Childhood in urban	-0.01	-12.15	-0.01	-11.80	-0.01	-12.01	-0.01	-11.85
	(0.01)	(18.71)	(0.01)	(18.97)	(0.01)	(18.71)	(0.01)	(18.89)
Primary	0.00	1.05	0.00	3.85	0.00	2.14	0.00	3.45
	(0.02)	(22.64)	(0.02)	(23.16)	(0.02)	(22.75)	(0.02)	(23.01)
Secondary	-0.08***	-82.48***	-0.09***	-98.77***	-0.09***	-88.84***	-0.09***	-96.46***
	(0.01)	(18.20)	(0.01)	(18.72)	(0.02)	(21.99)	(0.01)	(18.82)
Post sec. education	-0.10***	-65.28***	-0.11***	-99.19***	-0.10***	-78.51**	-0.11***	-94.39***
	(0.02)	(25.26)	(0.02)	(25.91)	(0.02)	(36.53)	(0.02)	(26.63)
Graduate education	0.01	163.13***	-0.01	120.16***	0.00	146.36***	-0.01	126.24***
	(0.02)	(39.22)	(0.02)	(39.05)	(0.03)	(50.26)	(0.02)	(39.69)
Brahmin	-0.03*	-63.29**	-0.04**	-67.97**	-0.03**	-65.12**	-0.04**	-67.31**
	(0.02)	(29.29)	(0.02)	(29.54)	(0.02)	(29.23)	(0.02)	(29.39)
Forward	-0.03**	-41.47**	-0.03**	-36.51*	-0.03**	-39.53*	-0.03**	-37.21*
	(0.01)	(20.05)	(0.01)	(20.36)	(0.01)	(20.41)	(0.01)	(20.29)
SC and ST	0.07***	66.19***	0.07***	74.19***	0.07***	69.31***	0.07***	73.06***
	(0.01)	(17.88)	(0.01)	(18.25)	(0.01)	(18.79)	(0.01)	(18.18)
Muslim	-0.07***	-63.69***	-0.06***	-40.25*	-0.06***	-54.54**	-0.06***	-43.57*
	(0.01)	(21.22)	(0.01)	(22.24)	(0.02)	(27.16)	(0.01)	(22.25)
Christian and others	-0.02	2.86	-0.02	-4.06	-0.02	0.16	-0.02	-3.09
	(0.03)	(53.71)	(0.03)	(53.59)	(0.03)	(53.66)	(0.03)	(53.53)
Observations	6,277	6,277	6,277	6,277	6,277	6,277	6,277	6,277
R-squared	0.080	0.057	0.0580	0.0223	0.0763	0.0519	0.0635	0.0315

Notes: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Standard errors are reported in parentheses.
Woman specific control variables: age at marriage, age, age square, average district level ln wage rate, marital status (married versus divorced and widowed), urban place of residence, childhood place of residence if urban, educational attainments: primary, secondary, post-secondary graduation and no education is base category, caste: Hindu Brahmin, Hindu Forward class, SC and ST, Muslim, Christian and others and OBC is considered as base category, land (unearned wealth) and the regions of India: Northern, North-Eastern, Central, Eastern, Western.
Source: Estimates are based on author's own calculation using the IHDS-II dataset.

A general theoretical model of labour supply proposes that an increase in unearned household wealth discourages women from labour market participation. Since, more that 60% of women are from rural settlements, I use land ownership as a proxy measure for unearned household wealth. The empirical results in Table 3.3 reveal that, on average, having land reduces the probability of female labour market participation by 5 percentage points (see second column) and the annual labour supply in the market by 79 hours on average (see third column).[41] These results are statistically significant at the 1% level. These negative impacts of unearned wealth on Indian female labour market outcomes are consistent with the labour economics literature of advanced countries.

I now move on to the other relevant demographic characteristics, such as age of women, marital status, place of residence, education, religion and caste. Caste is considered relevant in this analysis because the administrative caste categories is likely to play an important role in determining female labour market participation in India (Eswaran et al., 2013).

The result in Table 3.3 reveals that the women's age does not seem to have any impact on women's labour market participation when their children are young.[42]

Married women are 20 percentage points less likely to participate in the labour market compared to widowed or divorced women. Similarly, married women work for 303 hours less per year on average compared to those who are widowed and divorced. Women in urban settlements are 8 percentage points less likely to participate in the labour market and work for 59 hours less annually compared to women in rural settlements.

There are five categories for women's educational attainments, such as no education, primary education (year 1–5), secondary education (year 6-10), post secondary (year 11-12 and some undergraduate level education), graduate (year 15 and higher education). Women having 15

[41] Land ownership is considered as an exogenous variable in this analysis because 66% of women are from rural settlements who hold property as land. Land as property is generally inherited over generations.

[42] For the sample of women with young children, the turning point for the impact of female age on labour market participation is not statistically significant. I have used post-estimation 'nlcom' command to test this non-linear proposition as follows: $H_0 : b[\text{mother age}]/2 \times (-b[\text{mother age squared}]) = 0$ against $H_1 : b[\text{mother age}]/2 \times (-b[\text{mother age squared}]) \neq 0$.

or more years of education are assumed to have completed their under-graduate degree and hence are categorised as graduates. Women with graduate level education, on average, have null effect on labour market participation but they work, on average, 163 hours more in the labour market on an annual basis compared to women having no educational qualification at all. This is reasonable because higher educated women are likely to be more ambitious towards jobs fulfilments and are likely to work for longer hours to fulfil the job requirements. These women with graduate level education are likely to work in the official (i.e., formal) employment sector (see Appendix Table A3.26).

In India, the administrative caste groups play a vital role in determining female labour market outcomes (Eswaran et al., 2013). Brahmin and Forward Class enjoy many socio-economic advantages, such as in education and occupations whereas Scheduled Castes (SC), Schedule Tribes (ST) and Other Backward Classes (OBC) experience many disadvantages in terms of education, income, religious practices and territories of residence. Among these disadvantaged groups, SCs are socially oppressed groups and are called 'ex-untouchable' jatis or Dalits. SC group does not fall in the Indian 'varna' system and they are therefore called 'avarnas'. They are considered so low that they are considered unfit to be given a varna (Deshpande, 2011). STs (known as Adivasis) are geographically isolated tribal group of people. Government of India has geographically isolated STs in order to protect and preserve their original culture (Deshpande, 2013).[43] OBCs are known as 'sudras' who fall within the 'varna' system but are placed in the lowest category of the system. OBCs have prospered overtime. Their economic condition has improved over time through social mobility in their occupations and in political standing (Deshpande, 2011, 2013).[44]Hence, the participation of women belonging to SC/ST and OBC are expected to be higher compared to Brahmins and Forward Class. Again, compared to OBC women, the SC and ST women are likely to partic-

[43]Chapter 4 discusses on the caste system in India in further details.

[44]Within OBC groups, there is a 'creamy layer' OBC group of people who have better economic conditions and hence, they are not eligible for government-sponsored educational and professional benefit programmes that are implemented for economically backward group of people.

ipate more in the labour market as they are from poorer economic environment.

The findings in Table 3.3 support this characterisation and reveal that SC/ST women are 7 percentage points more likely to participate in the labour market compared to OBC women. Similarly, women from the General category, such as Brahmin and Forward Class, are 3 percentage points less likely to participate in the labour market compared to women from OBC households. The results are statistically significant at the conventional levels. In terms of hours of work, SC/ST women work 66 more hours than OBC women on an annual basis, whereas Brahmin (Forward Class) women work approximately 63 (41) fewer hours on an annual basis compared to OBC women, at any given *wage rate*.[45]

Causal impact of young children on women's labour market outcomes:

Before interpreting the 2SLS results in Table 3.3, let us first look at the empirical results on validity of the instruments (see Appendix Tables A3.38). The first three columns of the table report the first stage regression results for the sample of women with young children (i.e., it depict the regression equation where the fertility variable is regressed on the instrumental variables). The Kleibergen-Paap Wald F-statistics are 195 and 51 respectively for *twins* and *first-born girl* respectively. These F-statistics are sufficiently larger than the rule-of-thumb of 10 for relevance and they confirm that the two identifying instruments are relevant for IV analysis. The Hansen J statistic for the combined instruments in the young children sample is 0.358 (0.655) for the participation (hours of labour supply) outcome, with the corresponding Chi-square p-value being 0.550 (0.418). This explains that the two instruments are orthogonal to the error process in the structural equation of primary policy interest (i.e., Equation 3.11) and thus comprise a valid set of over-identifying instruments.

Using a 2SLS procedure (see Table 3.3), I find that an additional young child, on average, reduces the probability of female labour market participation by 10–11 percentage points

[45] Wage rate offered to women belonging to different caste groups are more or less similar in rural areas. However, in urban areas, the wage rate received by Brahmin and Forward class women are slightly higher than that received by the lower classes.

and reduces the annual hours of labour supply by approximately 176–202 hours on average. These results are statistically significant at the 1% level.[46] Two stage least squares estimates are larger in magnitude than the OLS estimates. This is because in an instrumental variable (IV) analysis we identify average effects for sub-populations that are induced by the instruments.[47]

Estimates using probit and tobit models are presented in Appendix Table A3.40), I find the estimates of fertility are statistical insignificant.

It is difficult to determine exactly why the estimates between the LPM and 2SLS models and the probit and tobit models differ in magnitude and statistical significance. However, a key issue is that the latter maximum likelihood models are more vulnerable to mis-specification than the OLS-based models. This is particularly so in regard to the violation of the assumptions for normality and homoscedasticity, both central to the specification of the probit and tobit models. The violation of these assumptions will lead to inconsistency and inefficiency in the maximum likelihood estimates and this may partly explain the differences in the estimates obtained using these contrasting econometric methods.

Effect of school-age children on women's labour market outcomes:

Table 3.4 reveals that the school-aged children has null effects on female labour market outcomes (refer to the second and third columns).

In regard to the economic variables, the empirical results reveal that a 1% increase in the

[46]By considering a sample of women who have a combination of 0–5 and 6–17 year old children, I find same negative impact of fertility on female labour market participation. There are 5,287 women in this sample. Using twins, the 2SLS result shows that an additional child, on average, reduces the probability of female labour market participation by 11 percentage points; statistically significant at the 1 percent level (see Appendix Table A3.50). This finding confirms that the trade-off between fertility and female labour market participation is evident in the presence of young children. It would also be interesting to examine how the presence of older children (18 years or above) may affect the female labour market outcomes, following Heath (2017). However, the current identification strategy does not allow for this and this could be examined using a different dataset and by developing an alternative identification strategy.

[47]Heckman procedure may control for the selection of women into the labour market but it does not allow for instrumenting the fertility variable to examine its causal impacts. The recent STATA command 'egress' that allows for such instrumentation, however, does not produce estimates based on unconditional means.

wage rate increases the likelihood of labour market participation of women having school-aged children by 0.68 of a percentage point (see the second column). Similarly, 1% increase in the wage rate is associated with an increase of approximately 11 hours of labour supply in the market on an annual basis (see the third column). These results are statistically significant at the 1% level.

Wealth is expected to have a negative impact on female labour market outcomes. The findings in Table 3.4 support our prediction and confirm that the ownership of land reduces female labour market participation by 10 percentage points. In addition, it reduces the annual labour supply by 225 hours on average. These findings are statistically significant at the 1% level.

We now look at the demographic variables. Age of women has positive association with women's labour market outcomes. The results in Table 3.4 show that an increase in a year of women's age increases their labour market participation by 1 percentage point and annual hours of labour supply by 43 hours on average, when they have school-aged children. These results are statistically significant at 5% and 1% levels. The turning point for the impact of female age on labour market participation is 46.52 years for women with school-aged children (statistically significant at 1% level). Married women who have school-aged children are 26 percentage points less likely to participate in the labour market compared to widowed and divorced women. Similarly, married women work for approximately 626 hours less on an annual basis compared to those who are widowed and divorced. Women residing in urban areas with school-aged children are 17 percentage points less likely to participate in the labour market and work for 164 hours less annually compared to those residing in rural areas. Women with graduate level education work in the labour market for approximately 250 more hours on an annual basis compared to those who have no educational attainment at all. Women with school-aged children work for longer hours (see Table 3.4) than women with young children (see Table 3.3). This is fairly reasonable because mothers are likely to have more time to work when their children are older.

SC/ST women are 14 percentage points more likely to participate in the labour market compared to OBC women. Similarly, Brahmin (Forward Class) women are 11 (9) percentage points less likely to participate in the labour market compared to OBC women. On average, SC/ST women work 192 hours more on an annual basis than OBC women whereas Brahmin (Forward Class) women work 87 (85) fewer hours on an annual basis than women belonging to the OBC category at any given wage rate.

Causal impact of school-aged children on female labour market outcomes:

Before interpreting the results, we first look at the empirical test for the validity of the instruments (see Appendices A3.38). The last three columns of Appendices A3.38 reports the first stage regression results for the sample of women with school-aged children (i.e., the regression of fertility variable on the instruments). The Kleibergen-Paap Wald F-statistics are 167 and 239 respectively for *twins* and *first-born girl* and are sufficiently larger than the rule-of-thumb of 10 for relevance, confirming that these two over-identifying instruments are relevant for analysis. The Hansen J statistic for the combined instruments in the school-aged children sample is 0.062 (0.156) for the participation (hours of labour supply) outcome, with the corresponding Chi-square p-value is 0.803 (0.693). The Chi-square p-value for the participation outcome is large but less than 0.9.

The 2SLS results, using combined instruments, reveal that having a school-aged child increases the probability of female labour market participation by 4 percentage points (see the fifth column of Table 3.4). This result is statistically significant at the 10% level. However, we may need to take precautions while interpreting this result because the Chi-square p-value for Hansen J statistic is large although less than 0.9 for the sample of women with school-aged children (see Appendix Table A3.38).

Estimates using probit and tobit models are presented in Appendix Table A3.41), I find the estimates of fertility are statistical insignificant. The reason for this difference is same as discussed earlier.

In the rest of the tables, results relating to the effect of fertility and the economic variables, namely regional wage rate and land ownership, are interpreted.

Table 3.4: 2SLS: Effect of school-aged children on female labour market outcomes

Mother Age 18-54	LPM Part.	OLS Hours	2SLS Twins Part.	2SLS Twins Hours	2SLS FG Part.	2SLS FG Hours	2SLS Twins & FG Part.	2SLS Twins & FG Hours
Main variable:								
No. of children	-0.01	-11.09	0.03	42.71	0.05	75.44	0.04*	62.04
	(0.01)	(8.19)	(0.04)	(64.49)	(0.03)	(54.52)	(0.02)	(42.50)
Economic variables:								
Log wage rate	0.68***	1112.58***	0.73***	1182.22***	0.75***	1224.59***	0.74***	1207.24***
	(0.07)	(129.34)	(0.09)	(155.52)	(0.09)	(147.76)	(0.08)	(141.52)
Land ownership (0/1)	-0.10***	-225.40***	-0.10***	-225.54***	-0.10***	-225.62***	-0.10***	-225.59***
	(0.01)	(18.37)	(0.01)	(18.39)	(0.01)	(18.45)	(0.01)	(18.42)
Demographic variables:								
Age at marriage	-0.00***	-4.20*	-0.00	-2.55	-0.00	-1.54	-0.00*	-1.95
	(0.00)	(2.45)	(0.00)	(3.12)	(0.00)	(2.98)	(0.00)	(2.77)
Age of mother	0.01**	42.68***	0.00	27.40	-0.00	18.10	0.00	21.91
	(0.01)	(11.43)	(0.01)	(21.21)	(0.01)	(19.27)	(0.01)	(16.44)
Age mother square	-0.00	-0.50***	0.00	-0.29	0.00	-0.17	0.00	-0.22
	(0.00)	(0.15)	(0.00)	(0.28)	(0.00)	(0.26)	(0.00)	(0.22)
Married	-0.26***	-626.29***	-0.27***	-644.49***	-0.28***	-655.56***	-0.28***	-651.03***
	(0.02)	(48.60)	(0.03)	(53.08)	(0.02)	(52.39)	(0.02)	(50.84)
Urban	-0.17***	-164.05***	-0.16***	-161.83***	-0.16***	-160.49***	-0.16***	-161.04***
	(0.01)	(21.09)	(0.01)	(21.25)	(0.01)	(21.32)	(0.01)	(21.22)
Childhood in urban	-0.04***	-53.54***	-0.04***	-54.15***	-0.04***	-54.52***	-0.04***	-54.37***
	(0.01)	(20.44)	(0.01)	(20.46)	(0.01)	(20.50)	(0.01)	(20.48)
Primary	-0.08***	-62.79***	-0.08***	-56.98**	-0.08***	-53.45**	-0.08***	-54.89**
	(0.01)	(22.01)	(0.01)	(22.97)	(0.01)	(22.82)	(0.01)	(22.46)
Secondary	-0.19***	-197.64***	-0.18***	-187.32***	-0.18***	-181.04***	-0.18***	-183.61***
	(0.01)	(19.99)	(0.01)	(23.19)	(0.01)	(22.30)	(0.01)	(21.29)
Post sec. education	-0.15***	-54.04	-0.14***	-33.95	-0.13***	-21.73	-0.13***	-26.74
	(0.02)	(36.98)	(0.02)	(43.74)	(0.02)	(42.00)	(0.02)	(39.94)
Graduate education	0.00	250.33***	0.02	272.15***	0.02	285.43***	0.02	279.99***
	(0.02)	(48.17)	(0.03)	(54.78)	(0.03)	(53.19)	(0.02)	(51.26)
Brahmin	-0.11***	-86.98***	-0.10***	-84.56**	-0.10***	-83.09**	-0.10***	-83.69**
	(0.02)	(33.20)	(0.02)	(33.40)	(0.02)	(33.64)	(0.02)	(33.48)
Forward	-0.09***	-84.75***	-0.08***	-77.27***	-0.08***	-72.73***	-0.08***	-74.59***
	(0.01)	(21.02)	(0.01)	(22.79)	(0.01)	(22.45)	(0.01)	(21.87)
SC and ST	0.14***	191.65***	0.13***	187.16***	0.13***	184.42***	0.13***	185.54***
	(0.01)	(19.87)	(0.01)	(20.54)	(0.01)	(20.32)	(0.01)	(20.13)
Muslim	-0.13***	-143.98***	-0.15***	-163.93***	-0.15***	-176.07***	-0.15***	-171.10***
	(0.02)	(25.66)	(0.02)	(34.83)	(0.02)	(33.15)	(0.02)	(30.29)
Christian and others	-0.12***	-108.57**	-0.11***	-101.17**	-0.11***	-96.66*	-0.11***	-98.51*
	(0.02)	(50.05)	(0.03)	(50.99)	(0.03)	(50.83)	(0.03)	(50.58)
Observations	9,513	9,513	9,513	9,513	9,513	9,513	9,513	9,513
R-squared	0.196	0.152	0.191	0.149	0.187	0.143	0.189	0.146

Notes: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$. Standard errors are reported in parentheses.
Woman specific control variables: age at marriage, age, age square, average district level ln wage rate, marital status (married versus divorced and widowed), urban place of residence, childhood place of residence if urban, educational attainments: primary, secondary, post-secondary graduation and no education is base category, caste: Hindu Brahmin, Hindu Forward class, SC and ST, Muslim, Christian and others and OBC is considered as base category, land (unearned wealth) and the regions of India: Northern, North-Eastern, Central, Eastern, Western.
Source: Estimates are based on author's own calculation using the IHDS-II dataset.

3.6.2. Heterogeneity by types of settlement: Urban versus rural areas

The descriptive statistics in Appendix Table A3.26 show that in urban areas, 23% of women with a graduate level educational qualification participate in the labour market. This rate is similar (24.5%) to that for rural women with a graduate level educational qualification. The lack of quality and affordable childcare facilities in formal employment sector occupations could render participation in the labour market by highly educated mothers a less preferred option.

In contrast, 31% of urban women among those with no academic qualifications participate in the labour market (see Appendix Table A3.26). This rate for rural women is 41% (32% higher than in urban areas). The higher participation rates among uneducated rural women could potentially be due to poor socio-economic conditions of the households, which could be driving them into the labour market (Eswaran et al., 2013; Papanek, 1979). These rural women work primarily in informal agricultural occupations where there are no restrictions on taking children to work. In addition, 66% of the overall sample of women live in rural areas. Therefore, it would be plausible to assume that school-aged children are less likely to impose negative consequences on female labour market outcomes, whereas young children may still have negative impacts on the selected outcomes because of childcare requirements.

The heterogeneity of empirical results by type of settlement (i.e. urban and rural settlements) is presented in Tables 3.5–3.8. Tables 3.5 and 3.6 (Tables 3.7 and 3.8) present the results for urban (rural) women with young and school-aged children respectively.

In urban areas, Table 3.5 reveals that there is a negative association between having young children and female labour market outcomes. On average, an additional young child reduces the probability of an urban woman's labour market participation by 2 percentage points (statistically significant at the 5% level), and it reduces the annual labour supply by 38 hours on average (statistically significant at the 10% level).

The 2SLS results reveal that an additional young child, on average, reduces the probability of female labour market participation by 12–13 percentage points, and it reduces the annual labour supply by 231–234 hours on average. These results are statistically significant at the 1% level.

In urban settlements, for women having young children, a 1% increase in the wage rate increases the probability of female labour market participation by 0.35 of a percentage point, and it increases female labour supply by approximately 6 hours on an annual basis in urban areas (see second and third columns of Table 3.5). These results are statistically significant at the 1% level.

Table 3.5: 2SLS: Effect of young children on urban female labour market outcomes

Mother Age 18-54	LPM Part.	OLS Hours	2SLS Twins Part.	2SLS Twins Hours	2SLS FG Part.	2SLS FG Hours	2SLS Twin & FG Part.	2SLS Twin & FG Hours
Main variable:								
No. of children	-0.02**	-38.06*	-0.12***	-233.66***	-0.16	-214.43	-0.13***	-230.76***
	(0.01)	(21.39)	(0.02)	(42.74)	(0.13)	(274.16)	(0.03)	(55.07)
Economic variables:								
Log wage rate	0.35***	621.83***	0.42***	759.90***	0.45***	746.33**	0.43***	757.86***
	(0.11)	(219.06)	(0.11)	(221.34)	(0.15)	(297.45)	(0.11)	(223.68)
Land ownership (0/1)	0.00	15.67	-0.00	2.01	-0.01	3.35	-0.00	2.21
	(0.02)	(49.01)	(0.02)	(49.39)	(0.02)	(52.48)	(0.02)	(49.39)
Demographic variables:								
Age at marriage	-0.00	-1.09	-0.01**	-12.26*	-0.01	-11.17	-0.01**	-12.10*
	(0.00)	(5.86)	(0.00)	(6.44)	(0.01)	(16.97)	(0.00)	(6.81)
Age of mother	0.00	9.51	0.03**	52.17**	0.03	47.98	0.03**	51.54**
	(0.01)	(24.59)	(0.01)	(23.12)	(0.03)	(64.39)	(0.01)	(24.71)
Age mother square	0.00	0.07	-0.00	-0.55	-0.00	-0.49	-0.00	-0.54
	(0.00)	(0.43)	(0.00)	(0.39)	(0.00)	(0.96)	(0.00)	(0.41)
Married	-0.24***	-386.36**	-0.21**	-333.60**	-0.20**	-338.78*	-0.21**	-334.38**
	(0.09)	(164.02)	(0.09)	(163.73)	(0.09)	(173.85)	(0.09)	(163.10)
Childhood in urban	-0.02	-27.91	-0.02	-33.99	-0.02	-33.39	-0.02	-33.90
	(0.01)	(29.01)	(0.01)	(29.37)	(0.01)	(30.89)	(0.01)	(29.45)
Primary	-0.03	-58.16	-0.02	-55.51	-0.02	-55.77	-0.02	-55.55
	(0.03)	(60.10)	(0.03)	(60.73)	(0.03)	(60.63)	(0.03)	(60.70)
Secondary	-0.08***	-140.19***	-0.08***	-157.79***	-0.09***	-156.06***	-0.09***	-157.53***
	(0.02)	(48.55)	(0.03)	(49.48)	(0.03)	(55.81)	(0.03)	(49.68)
Post sec. education	-0.09***	-132.94**	-0.11***	-168.23***	-0.12***	-164.76**	-0.11***	-167.70***
	(0.03)	(55.54)	(0.03)	(57.04)	(0.04)	(73.60)	(0.03)	(57.08)
Graduate education	0.02	103.03	-0.00	60.30	-0.01	64.50	-0.00	60.94
	(0.03)	(67.46)	(0.03)	(67.05)	(0.04)	(89.68)	(0.03)	(67.53)
Brahmin	-0.05*	-124.60**	-0.05*	-134.67**	-0.06*	-133.68**	-0.05*	-134.52**
	(0.03)	(57.22)	(0.03)	(58.14)	(0.03)	(58.70)	(0.03)	(58.00)
Forward	-0.02	-40.66	-0.02	-35.12	-0.02	-35.67	-0.02	-35.21
	(0.02)	(42.35)	(0.02)	(42.52)	(0.02)	(43.40)	(0.02)	(42.56)
SC and ST	-0.02	-31.82	-0.02	-26.62	-0.01	-27.13	-0.01	-26.70
	(0.02)	(38.41)	(0.02)	(38.90)	(0.02)	(40.05)	(0.02)	(38.99)
Muslim	-0.05***	-70.29*	-0.04**	-54.00	-0.04*	-55.60	-0.04**	-54.24
	(0.02)	(38.97)	(0.02)	(40.04)	(0.02)	(47.44)	(0.02)	(40.41)
Christian and others	0.02	62.18	0.02	56.18	0.02	56.77	0.02	56.27
	(0.05)	(98.90)	(0.05)	(98.33)	(0.05)	(98.48)	(0.05)	(98.30)
Observations	2,023	2,023	2,023	2,023	2,023	2,023	2,023	2,023
R-squared	0.061	0.059	0.028	0.030	0.0969	0.0349	0.0245	0.030

Notes: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$. Standard errors are reported in parentheses.
Woman specific control variables: age at marriage, age, age square, average district level ln wage rate, marital status (married versus divorced and widowed), urban place of residence, childhood place of residence if urban, educational attainments: primary, secondary, post-secondary graduation and no education is base category, caste: Hindu Brahmin, Hindu Forward class, SC and ST, Muslim, Christian and others and OBC is considered as base category, land (unearned wealth) and the regions of India: Northern, North-Eastern, Central, Eastern, Western.
Source: Estimates are based on author's own calculation using the IHDS-II dataset.

In Table 3.6, school-aged children have no impact on female labour market participation and hours of labour supply in urban areas.

The economic factors seem to have impacts on the selected outcomes for urban women with school-aged children. The table reveals that for an urban woman with school-aged children, a 1% increase in wage rate increases the probability of female labour market participation by 0.70 of a percentage point, and it increases the annual female labour supply by 14 hours per year on average (both are statistically significant at the 1% level). Land ownership reduces the probability of female labour market participation by 4 percentage points, and it reduces the annual female labour supply by 92 hours on average.

In the above two tables, we find evidence of negative impact of young children on female labour supply outcomes in urban settlements. However, such negative impacts are unobserved for school-aged children. A higher wage rate induces urban women to participate and work for longer hours in the labour market, irrespective of the age categories of children.

Table 3.6: 2SLS: Effect of school-aged children on urban female labour market outcomes

Mother Age 18-54	LPM Part.	OLS Hours	2SLS Twins Part.	2SLS Twins Hours	2SLS FG Part.	2SLS FG Hours	2SLS Twins & FG Part.	2SLS Twins & FG Hours
Main variable:								
No. of children	-0.00	-21.72	0.03	30.70	0.06	121.51	0.04	72.53
	(0.01)	(17.42)	(0.05)	(102.79)	(0.06)	(129.10)	(0.04)	(83.87)
Economic variables:								
Log wage rate	0.70***	1434.90***	0.72***	1473.90***	0.75***	1541.47***	0.73***	1505.02***
	(0.10)	(201.98)	(0.11)	(214.17)	(0.11)	(220.29)	(0.11)	(208.78)
Land ownership (0/1)	-0.04*	-91.65**	-0.04**	-94.37**	-0.04**	-99.06**	-0.04**	-96.53**
	(0.02)	(41.82)	(0.02)	(42.16)	(0.02)	(42.73)	(0.02)	(42.17)
Demographic variables:								
Age at marriage	-0.00	-4.66	-0.00	-2.40	-0.00	1.51	-0.00	-0.60
	(0.00)	(4.90)	(0.00)	(6.60)	(0.00)	(7.61)	(0.00)	(6.19)
Age of mother	0.04***	67.78**	0.03	51.22	0.02	22.53	0.02	38.00
	(0.01)	(26.31)	(0.02)	(41.18)	(0.02)	(48.59)	(0.02)	(37.00)
Age mother square	-0.00**	-0.74**	-0.00	-0.52	-0.00	-0.15	-0.00	-0.35
	(0.00)	(0.36)	(0.00)	(0.55)	(0.00)	(0.64)	(0.00)	(0.50)
Married	-0.34***	-820.20***	-0.35***	-837.47***	-0.36***	-867.37***	-0.36***	-851.24***
	(0.04)	(96.01)	(0.04)	(101.71)	(0.05)	(105.26)	(0.04)	(99.95)
Childhood in urban	-0.03**	-36.83	-0.03**	-35.81	-0.03*	-34.03	-0.03**	-34.99
	(0.01)	(29.78)	(0.01)	(29.77)	(0.01)	(30.24)	(0.01)	(29.92)
Primary	-0.13***	-213.71***	-0.13***	-205.56***	-0.12***	-191.43***	-0.12***	-199.05***
	(0.03)	(51.17)	(0.03)	(52.77)	(0.03)	(55.73)	(0.03)	(52.69)
Secondary	-0.21***	-313.27***	-0.20***	-302.88***	-0.20***	-284.87***	-0.20***	-294.58***
	(0.02)	(42.68)	(0.02)	(46.40)	(0.03)	(49.85)	(0.02)	(45.37)
Post sec. education	-0.18***	-210.34***	-0.17***	-192.06***	-0.16***	-160.40**	-0.17***	-177.48***
	(0.03)	(55.14)	(0.03)	(63.86)	(0.04)	(72.78)	(0.03)	(62.24)
Graduate education	-0.05*	56.34	-0.04	74.61	-0.03	106.26	-0.04	89.19
	(0.03)	(64.18)	(0.03)	(72.58)	(0.04)	(79.51)	(0.03)	(70.59)
Brahmin	-0.06**	-80.34	-0.06**	-72.99	-0.05*	-60.25	-0.05**	-67.12
	(0.02)	(54.38)	(0.03)	(55.74)	(0.03)	(58.09)	(0.03)	(55.70)
Forward	-0.05***	-60.12	-0.05**	-51.99	-0.04*	-37.89	-0.04**	-45.50
	(0.02)	(37.57)	(0.02)	(40.10)	(0.02)	(43.00)	(0.02)	(39.58)
SC and ST	0.07***	174.84***	0.07***	170.80***	0.07***	163.81***	0.07***	167.58***
	(0.02)	(41.73)	(0.02)	(42.03)	(0.02)	(42.82)	(0.02)	(41.93)
Muslim	-0.11***	-151.51***	-0.12***	-172.93***	-0.13***	-210.03***	-0.12***	-190.02***
	(0.02)	(41.87)	(0.03)	(59.69)	(0.03)	(68.45)	(0.03)	(54.78)
Christian and others	0.01	12.43	0.01	14.33	0.01	17.64	0.01	15.85
	(0.04)	(88.72)	(0.04)	(88.53)	(0.04)	(88.81)	(0.04)	(88.58)
Observations	3,407	3,407	3,407	3,407	3,407	3,407	3,407	3,407
R-squared	0.138	0.130	0.135	0.128	0.124	0.113	0.131	0.123

Notes: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Standard errors are reported in parentheses.
Woman specific control variables: age of marriage, age, age square, average district level ln wage rate, marital status (married versus divorce or widow), urban place of residence, childhood place of residence if urban, educational attainments: primary, secondary, post-secondary graduation and no education is base category, caste: Hindu Brahmin, Hindu Forward class, SC and ST, Muslim, Christian and others and OBC is considered as base category, land (unearned wealth) and the regions of India: Northern, North-Eastern, Central, Eastern, Western.
Source: Estimates are based on author's own calculation using the IHDS-II dataset.

Tables 3.7 and 3.8 present the results for rural women with young and school-aged children respectively. In Table 3.7, 2SLS results, with *twins* and the combined instruments, show that an increase in an additional young child reduces the annual labour supply in rural areas by more than 140 hours on average (see fifth and nineth columns). This result is statistically significant at the 1% level although there is null effect of young children on rural women's labour market participation.

For a rural woman with young children, a 1% increase in the wage rate increases female labour market participation on average by 0.27 of a percentage point (statistically significant at the 5% level), and it increases the annual labour supply by 4.5 hours approximately (statistically significant at the 1% level).

Land ownership reduces the probability of female labour market participation by 5 percentage points (statistically significant at the 1% level), and it reduces the annual labour supply by 94 hours on average (statistically significant at the 1% level).

Comparing by settlement types, the study finds that the impact of young children on female labour market outcomes are less severe in rural areas than in urban areas. This is fairly reasonable because the majority of women working in rural agricultural or other informal occupations often carry their children to work-place; this is less likely in urban formal sector occupations. In addition, the results reveal that female labour market participation and the annual hours of labour supply are more sensitive to the wage rate in urban areas compared to rural areas. This indicates that urban women are more responsive to higher wage rate than rural women who work to meet their basic necessity.

Table 3.7: 2SLS: Effect of young children on rural female labour market outcomes

Mother Age 18-54	LPM Part.	OLS Hours	2SLS Twins Part.	2SLS Twins Hours	2SLS FG Part.	2SLS FG Hours	2SLS Twins & FG Part.	2SLS Twins & FG Hours
Main variable:								
No. of children	-0.01	-20.22	-0.09	-171.25***	-0.01	-70.57	-0.07	-142.77***
	(0.01)	(12.93)	(0.05)	(39.87)	(0.11)	(141.61)	(0.05)	(48.93)
Economic variables:								
Log wage rate	0.27**	451.66***	0.26**	424.09**	0.27**	442.47***	0.26**	429.29***
	(0.12)	(165.42)	(0.12)	(166.77)	(0.12)	(166.79)	(0.12)	(166.20)
Land ownership (0/1)	-0.05***	-94.18***	-0.05***	-97.74***	-0.05***	-95.37***	-0.05***	-97.07***
	(0.01)	(17.10)	(0.01)	(17.40)	(0.01)	(17.32)	(0.01)	(17.28)
Demographic variables:								
Age at marriage	-0.01***	-7.59***	-0.01***	-15.10***	-0.01*	-10.10	-0.01***	-13.69***
	(0.00)	(2.86)	(0.00)	(3.41)	(0.01)	(7.47)	(0.00)	(3.63)
Age of mother	0.02	25.20	0.04**	70.48***	0.02	40.30	0.04*	61.94**
	(0.01)	(20.14)	(0.02)	(22.99)	(0.03)	(47.44)	(0.02)	(24.84)
Age mother square	-0.00	-0.23	-0.00	-0.92**	-0.00	-0.46	-0.00	-0.79*
	(0.00)	(0.38)	(0.00)	(0.41)	(0.00)	(0.77)	(0.00)	(0.44)
Married	-0.18***	-259.98***	-0.14**	-191.12**	-0.18**	-237.02**	-0.15**	-204.10**
	(0.07)	(94.78)	(0.07)	(96.10)	(0.08)	(110.92)	(0.07)	(95.83)
Childhood in urban	-0.02	-5.59	-0.02	-0.39	-0.02	-3.86	-0.02	-1.37
	(0.02)	(24.23)	(0.02)	(24.54)	(0.02)	(24.27)	(0.02)	(24.33)
Primary	0.01	15.63	0.01	18.24	0.01	16.50	0.01	17.75
	(0.02)	(24.00)	(0.02)	(24.45)	(0.02)	(24.07)	(0.02)	(24.28)
Secondary	-0.08***	-64.35***	-0.09***	-79.05***	-0.08***	-69.25***	-0.09***	-76.28***
	(0.02)	(19.31)	(0.02)	(19.76)	(0.02)	(23.89)	(0.02)	(19.97)
Post sec. education	-0.09***	-39.72	-0.11***	-70.54**	-0.09***	-50.00	-0.10***	-64.73**
	(0.02)	(29.41)	(0.02)	(29.60)	(0.03)	(44.89)	(0.02)	(31.81)
Graduate education	-0.02	150.83***	-0.04	113.13**	-0.02	138.26**	-0.04	120.24**
	(0.03)	(54.32)	(0.03)	(54.40)	(0.04)	(64.94)	(0.03)	(55.16)
Brahmin	-0.02	-21.96	-0.03	-23.71	-0.02	-22.54	-0.02	-23.38
	(0.02)	(31.41)	(0.02)	(31.24)	(0.02)	(31.10)	(0.02)	(31.13)
Forward	-0.05***	-55.01***	-0.05***	-51.40**	-0.05***	-53.80**	-0.05***	-52.08**
	(0.02)	(20.90)	(0.02)	(21.30)	(0.02)	(21.13)	(0.02)	(21.15)
SC and ST	0.10***	99.48***	0.10***	107.86***	0.10***	102.27***	0.10***	106.28***
	(0.01)	(19.73)	(0.02)	(20.19)	(0.02)	(20.74)	(0.02)	(19.97)
Muslim	-0.08***	-55.73**	-0.07***	-32.20	-0.08***	-47.88	-0.07***	-36.63
	(0.02)	(24.34)	(0.02)	(25.94)	(0.02)	(31.11)	(0.02)	(25.41)
Christian and others	-0.05	-31.89	-0.05*	-40.14	-0.05	-34.64	-0.05	-38.59
	(0.03)	(55.97)	(0.03)	(55.86)	(0.03)	(56.00)	(0.03)	(55.74)
Observations	4,254	4,254	4,254	4,254	4,254	4,254	4,254	4,254
R-squared	0.097	0.078	0.084	0.047	0.097	0.075	0.090	0.058

Notes: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Standard errors are reported in parentheses.
Woman specific control variables: age of marriage, age, age square, average district level ln wage rate, marital status (married versus divorce or widow), urban place of residence, childhood place of residence if urban, educational attainments: primary, secondary, post-secondary graduation and no education is base category, caste: Hindu Brahmin, Hindu Forward class, SC and ST, Muslim, Christian and others and OBC is considered as base category, land (unearned wealth) and the regions of India: Northern, North-Eastern, Central, Eastern, Western.
Source: Estimates are based on author's own calculation using the IHDS-II dataset.

Let us now look at the impact on school-aged children on female labour market outcomes in the rural areas. Table 3.7 reveals that the school-aged children have null effect on rural women's labour supply outcomes. This is fairly reasonable because of the two opposite effects may be balancing one another to generate a null effect. On one hand, when children are in schools, women get more time to spend at work. On the other hand, when children grow up, they start taking household financial responsibilities to supplement family incomes in rural areas thus freeing women from market jobs.

It is to be noted that rural women generally take part in unpaid economic activities by producing goods and services for household businesses. This is beyond the scope of the current investigation.

Table 3.8: 2SLS: Effect of school-aged children on rural female labour market outcomes

Mother Age 18-54	LPM Part.	OLS Hours	2SLS Twins Part.	2SLS Twins Hours	2SLS FG Part.	2SLS FG Hours	2SLS Twins & FG Part.	2SLS Twins & FG Hours
Main variable:								
No. of children	-0.01	-8.84	0.02	18.98	0.04	54.77	0.03	41.98
	(0.01)	(9.06)	(0.05)	(80.43)	(0.04)	(55.63)	(0.03)	(46.47)
Economic variables:								
Log wage rate	0.68***	901.66***	0.72***	948.56***	0.75***	1008.90***	0.74***	987.33***
	(0.10)	(165.42)	(0.13)	(218.48)	(0.12)	(193.17)	(0.11)	(186.90)
Land ownership (0/1)	-0.11***	-255.73***	-0.11***	-255.29***	-0.11***	-254.72***	-0.11***	-254.92***
	(0.01)	(20.46)	(0.01)	(20.48)	(0.01)	(20.49)	(0.01)	(20.47)
Demographic variables:								
Age at marriage	-0.01***	-6.68**	-0.00**	-5.97*	-0.00*	-5.06*	-0.00**	-5.39*
	(0.00)	(2.76)	(0.00)	(3.36)	(0.00)	(3.03)	(0.00)	(2.92)
Age of mother	0.01	34.60***	0.00	27.17	-0.00	17.61	-0.00	21.02
	(0.01)	(12.71)	(0.02)	(24.45)	(0.01)	(19.50)	(0.01)	(17.48)
Age mother square	-0.00	-0.42**	0.00	-0.32	0.00	-0.19	0.00	-0.23
	(0.00)	(0.17)	(0.00)	(0.33)	(0.00)	(0.26)	(0.00)	(0.23)
Married	-0.22***	-509.46***	-0.22***	-519.23***	-0.23***	-531.79***	-0.23***	-527.30***
	(0.03)	(52.72)	(0.03)	(59.28)	(0.03)	(56.67)	(0.03)	(55.26)
Childhood in urban	-0.05***	-72.10***	-0.05***	-73.80***	-0.05***	-75.98***	-0.05***	-75.20***
	(0.02)	(27.24)	(0.02)	(27.50)	(0.02)	(27.42)	(0.02)	(27.29)
Primary	-0.06***	-26.51	-0.06***	-23.48	-0.06***	-19.59	-0.06***	-20.99
	(0.02)	(24.14)	(0.02)	(25.56)	(0.02)	(24.79)	(0.02)	(24.56)
Secondary	-0.18***	-164.19***	-0.17***	-158.52***	-0.17***	-151.22***	-0.17***	-153.83***
	(0.01)	(22.40)	(0.02)	(27.41)	(0.02)	(24.87)	(0.02)	(24.02)
Post sec. education	-0.14***	33.60	-0.13***	45.16	-0.12***	60.03	-0.12***	54.71
	(0.03)	(56.40)	(0.03)	(65.75)	(0.03)	(59.62)	(0.03)	(58.82)
Graduate education	0.01	422.61***	0.02	436.02***	0.03	453.27***	0.02	447.10***
	(0.05)	(103.01)	(0.05)	(109.87)	(0.05)	(106.57)	(0.05)	(105.44)
Brahmin	-0.15***	-86.28**	-0.15***	-87.83**	-0.15***	-89.82**	-0.15***	-89.11**
	(0.02)	(40.70)	(0.02)	(41.01)	(0.02)	(40.99)	(0.02)	(40.91)
Forward	-0.13***	-113.17***	-0.12***	-109.96***	-0.12***	-105.84***	-0.12***	-107.32***
	(0.02)	(25.01)	(0.02)	(26.79)	(0.02)	(25.82)	(0.02)	(25.61)
SC and ST	0.16***	199.31***	0.16***	197.00***	0.16***	194.02***	0.16***	195.08***
	(0.01)	(21.83)	(0.02)	(22.79)	(0.01)	(22.23)	(0.01)	(22.09)
Muslim	-0.14***	-129.03***	-0.14***	-137.43***	-0.15***	-148.24***	-0.15***	-144.38***
	(0.02)	(31.78)	(0.03)	(39.31)	(0.02)	(36.21)	(0.02)	(34.65)
Christian and others	-0.19***	-176.69***	-0.19***	-170.79***	-0.18***	-163.20***	-0.18***	-165.91***
	(0.03)	(58.36)	(0.03)	(61.47)	(0.03)	(60.51)	(0.03)	(60.04)
Observations	6,106	6,106	6,106	6,106	6,106	6,106	6,106	6,106
R-squared	0.205	0.192	0.203	0.190	0.198	0.186	0.200	0.188

Notes: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Standard errors are reported in parentheses.
Woman specific control variables: age of marriage, age, age square, average district level ln wage rate, marital status (married versus divorce or widow), urban place of residence, childhood place of residence if urban, educational attainments: primary, secondary, post-secondary graduation and no education is base category, caste: Hindu Brahmin, Hindu Forward class, SC and ST, Muslim, Christian and others and OBC is considered as base category, land (unearned wealth) and the regions of India: Northern, North-Eastern, Central, Eastern, Western.
Source: Estimates are based on author's own calculation using the IHDS-II dataset.

The table further reveals that for rural women with school-aged children, a 1% increase in the wage rate increases the probability of female labour market participation by 0.68 of a percentage point and the annual labour supply by approximately 9 hours on average. These results are statistically significant at the 1% level. Once again, the study finds that, in the sample of women with school-aged children female labour market outcomes are less sensitive to the wage rate in rural areas compared to urban areas. This could be for similar reasons to those discussed earlier.

For a rural woman with school-aged children, land ownership reduces the probability of female labour market participation by 11 percentage points, and it reduces the annual labour supply by 256 hours on average. These results are statistically significant at the 1% level. Female labour market outcomes are more sensitive to land ownership in rural areas compared to urban areas. This is reasonable because women who have land as family property may work on family lands without needing to work outside their households. In urban area, land may not be an accurate proxy for wealth and we may need to look for an alternative proxy for wealth for urban women.[48]

3.6.3. Heterogeneity by family type: Nuclear versus extended

The extended family is a dummy variable and is assigned a value of *one* if women are living with at least one member other than their own children and husband (if the women are married) or with at least one member other than their own children if women are widowed or divorced or not living with their husbands; a *zero* value otherwise.[49]

In urban (rural) areas, 45% (44%) of women live in nuclear families. This implies that the

[48] The information on household income available from IHDS-II data is not reliable as data on income are generally subject to reporting bias and, therefore, may not be an accurate measure for wealth. In addition, in the majority of cases, income earned by husbands is missing. Also, we may need to think about the exogeneity of an income measure. IHDS-II also has information on numbers of asset ownership but does not have information on its kinds.

[49] A woman's choice to reside in a nuclear or an extended family setting may be determined by the socio-economic conditions of the family members or by other unobserved factors that are difficult to measure. For the current purpose of the study, I assume that a woman's choice to reside in one of these settings is exogenously determined.

majority of the women live in an extended family setting in both the types of settlement. It is, therefore, crucial to try and examine the possible heterogeneity in labour market outcomes within the two types of family setting.

The OLS results in Table 3.9 reveal that, within a nuclear family setting, an increase in an additional young child reduces the probability of female labour market participation by 4 percentage points (statistically significant at the 1% level) and the hours of labour supply by 42 on an annual basis (statistically significant at the 10% level). This provided an empirical evidence of existing negative association between young children and women's labour supply outcomes.

Using an IV approach, the results in Table 3.9 show that an increase in an additional young child reduces the probability of female labour market participation by 25 (27) percentage points using *twins* (combined instruments), and it reduces the annual labour supply by 264 (289) hours on average using *twins* (combined instruments). The results are statistically significant at the 1% level.

The table shows that wage rate and land ownership do not seem to have any influence on female labour market outcomes when they have young children within the nuclear family setting.

Table 3.9: 2SLS: Effect of young children on female labour market outcomes in the nuclear family setting

Mother Age 18-54	LPM Part.	OLS Hours	2SLS Twins Part.	2SLS Twins Hours	2SLS FG Part.	2SLS FG Hours	2SLS Twins & FG Part.	2SLS Twins & FG Hours
Main variable:								
No. of children	-0.04***	-41.95*	-0.25***	-263.84***	-0.35	-394.68	-0.27***	-288.74***
	(0.02)	(22.12)	(0.03)	(37.02)	(0.23)	(311.50)	(0.05)	(66.51)
Economic variables:								
Log wage rate	-0.02	10.56	0.05	87.33	0.08	132.60	0.05	95.94
	(0.20)	(308.55)	(0.21)	(315.73)	(0.24)	(343.69)	(0.21)	(318.16)
Land ownership (0/1)	-0.01	-22.82	-0.01	-28.30	-0.01	-31.53	-0.01	-28.91
	(0.03)	(36.62)	(0.03)	(37.51)	(0.03)	(39.42)	(0.03)	(37.71)
Demographic variables:								
Age at marriage	-0.01***	-5.53	-0.02***	-15.38***	-0.02**	-21.18	-0.02***	-16.48***
	(0.00)	(5.48)	(0.00)	(5.69)	(0.01)	(15.10)	(0.00)	(6.28)
Age of mother	0.01	6.85	0.06***	60.77***	0.08	92.57	0.06***	66.82***
	(0.02)	(25.48)	(0.02)	(22.02)	(0.06)	(77.36)	(0.02)	(25.24)
Age mother square	0.00	0.03	-0.00***	-0.79**	-0.00	-1.27	-0.00***	-0.88**
	(0.00)	(0.45)	(0.00)	(0.38)	(0.00)	(1.20)	(0.00)	(0.43)
Married	-0.52*	-1322.04**	-0.42	-1213.61*	-0.37	-1149.68	-0.41	-1201.45*
	(0.27)	(611.50)	(0.31)	(657.87)	(0.36)	(713.23)	(0.32)	(665.81)
Urban	-0.14***	-130.83***	-0.15***	-135.74***	-0.15***	-138.64***	-0.15***	-136.29***
	(0.02)	(36.96)	(0.02)	(37.80)	(0.02)	(39.77)	(0.02)	(38.05)
Childhood in urban	-0.01	-8.13	-0.02	-19.64	-0.03	-26.42	-0.02	-20.93
	(0.03)	(43.01)	(0.03)	(43.88)	(0.03)	(47.50)	(0.03)	(44.09)
Primary	0.02	9.37	0.03	27.61	0.04	38.36	0.03	29.65
	(0.03)	(43.32)	(0.03)	(44.88)	(0.04)	(54.03)	(0.04)	(45.56)
Secondary	-0.08***	-68.82*	-0.09***	-88.66**	-0.10***	-100.36**	-0.10***	-90.89**
	(0.03)	(39.00)	(0.03)	(39.63)	(0.04)	(48.84)	(0.03)	(40.01)
Post sec. education	-0.05	-17.00	-0.08*	-47.72	-0.09*	-65.83	-0.08*	-51.17
	(0.04)	(64.73)	(0.04)	(65.13)	(0.05)	(80.90)	(0.04)	(66.21)
Graduate education	0.09	331.74***	0.07	305.98**	0.05	290.79**	0.06	303.09**
	(0.06)	(121.07)	(0.06)	(124.21)	(0.07)	(134.23)	(0.06)	(125.29)
Brahmin	-0.04	-45.55	-0.04	-44.51	-0.04	-43.90	-0.04	-44.39
	(0.05)	(70.65)	(0.06)	(70.49)	(0.06)	(73.10)	(0.06)	(70.85)
Forward	-0.12***	-156.19***	-0.13***	-167.13***	-0.14***	-173.58***	-0.14***	-168.36***
	(0.03)	(41.91)	(0.03)	(43.96)	(0.04)	(50.63)	(0.03)	(44.78)
SC and ST	0.07**	105.22***	0.07***	111.06***	0.07**	114.50***	0.07***	111.71***
	(0.03)	(38.16)	(0.03)	(38.77)	(0.03)	(40.17)	(0.03)	(38.86)
Muslim	-0.12***	-90.30**	-0.09***	-62.37	-0.08*	-45.91	-0.09***	-59.24
	(0.03)	(40.49)	(0.03)	(41.57)	(0.04)	(57.80)	(0.03)	(42.35)
Christian and others	-0.11	-59.62	-0.16*	-115.86	-0.19*	-149.03	-0.16**	-122.18
	(0.08)	(155.61)	(0.08)	(157.41)	(0.10)	(175.54)	(0.08)	(157.88)
Observations	1,665	1,665	1,665	1,665	1,665	1,665	1,665	1,665
R-squared	0.106	0.076	0.015	0.023	0.138	0.109	0.219	0.0102

Notes: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Standard errors are reported in parentheses.
Woman specific control variables: age of marriage, age, age square, average district level ln wage rate, marital status (married versus divorce or widow), urban place of residence, childhood place of residence if urban, educational attainments: primary, secondary, post-secondary graduation and no education is base category, caste: Hindu Brahmin, Hindu Forward class, SC and ST, Muslim, Christian and others and OBC is considered as base category, land (unearned wealth) and the regions of India: Northern, North-Eastern, Central, Eastern, Western. First stage regression results are presented in Appendix Table A3.39.
Source: Estimates are based on author's own calculation using the IHDS-II dataset.

The OLS results on Table 3.10 reveals in a nuclear family setting, an additional school-aged child increases women's labour market participation by a percentage point (statistically significant at the 10% level). This empirical result provides an evidence of a positive association between school-aged children and women's labour market participation in a nuclear family setting.

However, using an IV approach, the studies find a null effect of school-aged children on female labour market outcomes in a nuclear family setting.

The table further reveals that, for a woman with school-aged children in a nuclear family setting a 1% increase in the wage rate increases the probability of female labour market participation by 0.67 of a percentage point (see second column of the table), and it increases the annual labour supply by 11 hours on average (see third column of the table). These results are statistically significant at the 1% level.

For a woman with school-aged children in a nuclear family setting, land ownership reduces female labour market participation by 8 percentage points (see second column of the table), and it reduces the annual labour supply by 209 hours on average (see third column of the table). These results are statistically significant at the 1% level.

It is interesting to note that in a nuclear family setting, women with young children do not respond to increase in market wage or to land ownership but women with older school-aged children do. This results are fairly reasonable because childcare responsibilities are prioritised by women which is more of a compulsory requirement in a family setting where there are inadequate helping hands for household chores.

Table 3.10: 2SLS: Effect of school-aged children on female labour market outcomes in the nuclear family setting

Mother Age 18-54	LPM Part.	OLS Hours	2SLS Twins Part.	2SLS Twins Hours	2SLS FG Part.	2SLS FG Hours	2SLS Twins & FG Part.	2SLS Twins & FG Hours
Main variable:								
No. of children	-0.01*	-13.17	0.03	18.09	0.06	62.83	0.05	43.60
	(0.01)	(11.02)	(0.05)	(73.09)	(0.04)	(69.88)	(0.03)	(51.28)
Economic variables:								
Log wage rate	0.67***	1144.55***	0.73***	1187.09***	0.76***	1247.98***	0.75***	1221.81***
	(0.10)	(169.96)	(0.12)	(198.84)	(0.11)	(194.73)	(0.11)	(184.60)
Land ownership (0/1)	-0.08***	-208.91***	-0.08***	-209.42***	-0.08***	-210.17***	-0.08***	-209.85***
	(0.01)	(23.54)	(0.01)	(23.51)	(0.01)	(23.61)	(0.01)	(23.54)
Demographic variables:								
Age at marriage	-0.00**	-4.42	-0.00	-3.87	-0.00	-3.08	-0.00	-3.42
	(0.00)	(3.17)	(0.00)	(3.38)	(0.00)	(3.43)	(0.00)	(3.30)
Age of mother	0.01	38.07**	-0.00	30.22	-0.01	18.99	-0.01	23.82
	(0.01)	(15.79)	(0.01)	(23.79)	(0.01)	(23.64)	(0.01)	(20.19)
Age mother square	-0.00	-0.44**	0.00	-0.33	0.00	-0.18	0.00	-0.24
	(0.00)	(0.21)	(0.00)	(0.32)	(0.00)	(0.32)	(0.00)	(0.27)
Married	-0.35***	-816.98***	-0.36***	-825.30***	-0.36***	-837.20***	-0.36***	-832.09***
	(0.03)	(67.60)	(0.03)	(69.93)	(0.03)	(70.24)	(0.03)	(68.83)
Urban	-0.18***	-179.00***	-0.18***	-177.83***	-0.18***	-176.17***	-0.18***	-176.88***
	(0.02)	(27.32)	(0.02)	(27.39)	(0.02)	(27.54)	(0.02)	(27.40)
Childhood in urban	-0.06***	-85.11***	-0.06***	-85.12***	-0.06***	-85.15***	-0.06***	-85.14***
	(0.02)	(27.73)	(0.02)	(27.72)	(0.02)	(27.85)	(0.02)	(27.78)
Primary	-0.07***	-41.73	-0.06***	-37.32	-0.06***	-31.00	-0.06***	-33.71
	(0.02)	(28.81)	(0.02)	(30.53)	(0.02)	(30.18)	(0.02)	(29.52)
Secondary	-0.18***	-165.00***	-0.17***	-158.95***	-0.16***	-150.30***	-0.17***	-154.02***
	(0.02)	(27.50)	(0.02)	(30.50)	(0.02)	(30.38)	(0.02)	(28.89)
Post sec. education	-0.16***	-89.16*	-0.15***	-77.47	-0.14***	-60.73	-0.14***	-67.92
	(0.03)	(49.58)	(0.03)	(55.69)	(0.03)	(56.39)	(0.03)	(52.96)
Graduate education	0.03	284.40***	0.05	297.68***	0.06*	316.69***	0.06	308.52***
	(0.03)	(67.39)	(0.04)	(74.26)	(0.04)	(73.89)	(0.03)	(71.00)
Brahmin	-0.11***	-49.83	-0.11***	-48.63	-0.11***	-46.91	-0.11***	-47.65
	(0.03)	(49.89)	(0.03)	(49.97)	(0.03)	(50.33)	(0.03)	(50.13)
Forward	-0.10***	-96.61***	-0.09***	-92.55***	-0.09***	-86.73***	-0.09***	-89.23***
	(0.02)	(28.84)	(0.02)	(30.44)	(0.02)	(30.26)	(0.02)	(29.64)
SC and ST	0.14***	201.20***	0.13***	198.74***	0.13***	195.23***	0.13***	196.74***
	(0.02)	(25.96)	(0.02)	(26.54)	(0.02)	(26.45)	(0.02)	(26.20)
Muslim	-0.15***	-160.31***	-0.16***	-172.20***	-0.17***	-189.22***	-0.17***	-181.90***
	(0.02)	(32.71)	(0.03)	(42.22)	(0.03)	(42.82)	(0.02)	(38.15)
Christian and others	-0.12***	-107.48	-0.12***	-103.00	-0.11***	-96.58	-0.11***	-99.34
	(0.04)	(75.89)	(0.04)	(77.04)	(0.04)	(77.02)	(0.04)	(76.68)
Observations	5,358	5,358	5,358	5,358	5,358	5,358	5,358	5,358
R-squared	0.213	0.164	0.206	0.163	0.197	0.157	0.201	0.160

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Standard errors are reported in parentheses.
Woman specific control variables: age at marriage, age, age square, average district level ln wage rate, marital status (married versus divorced and widowed), urban place of residence, childhood place of residence if urban, educational attainments: primary, secondary, post-secondary graduation and no education is base category, caste: Hindu Brahmin, Hindu Forward class, SC and ST, Muslim, Christian and others and OBC is considered as base category, land (unearned wealth) and the regions of India: Northern, North-Eastern, Central, Eastern, Western. First stage regression results are presented in Appendix Table A3.39.
Source: Estimates are based on author's own calculation using the IHDS-II dataset.

Table 3.11 reveals that in an extended family setting, an additional young child reduces the annual labour supply of women by 25 hours on average (statistically significant at the 5% level although there is null effect on participation. Thus, the OLS result provides an evidence of a negative association between young children and female labour supply hours within an extended family setting.

Using an IV approach, the table reveals that, in an extended family setting, an additional young child reduces the annual labour supply of women by 182 (145) hours on average using *twins* (combined instrument) although, it show null effect on female labour market participation. The results are statistically significant at the 1% level. The magnitude of such a reduction in the hours of labour supply is smaller than in nuclear families. This is potentially due to the additional assistance in household chores or childcare responsibilities that women are likely to receive from other members in extended family settings.

The table further reveals that in an extended family setting, for a woman with young children, a 1% increase in the wage rate increases the probability of female labour market participation by 0.37 of a percentage point and it increases the annual labour supply by 6 hours on average. These results are statistically significant at the 1% level. This provides and evidence that women in extended family setting do respond to wage rate increases when they are in an extended family settings where there are additional members who are likely to support women's participation in the labour market and work for longer hours. Such wage effect on women's labour supply is absent in nuclear family setting with young children (see Table 3.9).

For women with young children in extended family setting, wealth in the form of land ownership reduces the annual labour supply by 45 hours but it has null effect on female labour market participation. The result is statistically significant at the 5% level.

Table 3.11: 2SLS: Effect of young children on female labour market outcomes in the extended family setting

Mother Age 18-47	LPM Part.	OLS Hours	2SLS Twins Part.	2SLS Twins Hours	2SLS FG Part.	2SLS FG Hours	2SLS Twins & FG Part.	2SLS Twins & FG Hours
Main variable:								
No. of children	-0.01	-24.63**	-0.07	-182.25***	0.02	-27.30	-0.04	-144.74***
	(0.01)	(12.33)	(0.04)	(36.70)	(0.09)	(141.34)	(0.04)	(44.09)
Economic variables:								
Log wage rate	0.37***	620.66***	0.37***	626.58***	0.37***	620.76***	0.37***	625.17***
	(0.09)	(146.18)	(0.09)	(147.10)	(0.09)	(146.05)	(0.09)	(146.52)
Land ownership (0/1)	-0.01	-45.49**	-0.01	-45.08**	-0.01	-45.48**	-0.01	-45.18**
	(0.01)	(19.20)	(0.01)	(19.43)	(0.01)	(19.17)	(0.01)	(19.32)
Demographic variables:								
Age at marriage	-0.00*	-3.44	-0.01**	-11.89***	-0.00	-3.58	-0.01**	-9.88***
	(0.00)	(2.87)	(0.00)	(3.43)	(0.01)	(7.98)	(0.00)	(3.61)
Age of mother	0.01	15.75	0.03*	59.11***	0.00	16.48	0.02	48.79**
	(0.01)	(18.05)	(0.02)	(20.06)	(0.03)	(43.84)	(0.02)	(21.74)
Age mother square	-0.00	-0.06	-0.00	-0.71**	0.00	-0.07	-0.00	-0.56
	(0.00)	(0.34)	(0.00)	(0.36)	(0.00)	(0.70)	(0.00)	(0.39)
Married	-0.21***	-282.28***	-0.18***	-225.47***	-0.22***	-281.32***	-0.19***	-238.99***
	(0.05)	(82.56)	(0.06)	(82.91)	(0.06)	(93.26)	(0.06)	(82.41)
Urban	-0.04***	-12.30	-0.04***	-17.56	-0.04***	-12.39	-0.04***	-16.30
	(0.01)	(22.32)	(0.01)	(22.49)	(0.01)	(22.62)	(0.01)	(22.37)
Childhood in urban	-0.01	-9.77	-0.01	-5.98	-0.01	-9.70	-0.01	-6.88
	(0.01)	(20.52)	(0.01)	(20.75)	(0.01)	(20.45)	(0.01)	(20.58)
Primary	-0.01	-6.99	-0.01	-10.24	-0.01	-7.04	-0.01	-9.47
	(0.02)	(25.81)	(0.02)	(26.31)	(0.02)	(26.00)	(0.02)	(26.09)
Secondary	-0.08***	-85.93***	-0.09***	-100.66***	-0.08***	-86.18***	-0.09***	-97.15***
	(0.01)	(19.95)	(0.02)	(20.63)	(0.02)	(24.57)	(0.02)	(20.77)
Post sec. education	-0.10***	-77.37***	-0.11***	-108.79***	-0.10***	-77.90*	-0.11***	-101.31***
	(0.02)	(27.06)	(0.02)	(28.01)	(0.02)	(40.46)	(0.02)	(28.81)
Graduate education	0.00	134.31***	-0.01	93.13**	0.01	133.61**	-0.01	102.93**
	(0.02)	(40.66)	(0.02)	(40.56)	(0.03)	(54.74)	(0.02)	(41.30)
Brahmin	-0.03	-59.46*	-0.03	-63.07*	-0.02	-59.52*	-0.03	-62.21*
	(0.02)	(32.18)	(0.02)	(32.33)	(0.02)	(32.08)	(0.02)	(32.14)
Forward	-0.00	-10.40	-0.00	-2.81	-0.01	-10.27	-0.00	-4.61
	(0.01)	(22.75)	(0.01)	(23.00)	(0.01)	(23.92)	(0.01)	(22.98)
SC and ST	0.07***	47.22**	0.07***	55.06***	0.06***	47.35**	0.07***	53.20***
	(0.01)	(19.70)	(0.01)	(20.04)	(0.01)	(21.16)	(0.01)	(20.02)
Muslim	-0.05***	-52.72**	-0.04***	-32.07	-0.06***	-52.37*	-0.05***	-36.98
	(0.01)	(25.02)	(0.01)	(26.18)	(0.02)	(30.82)	(0.01)	(26.05)
Christian and others	-0.00	19.46	-0.00	20.07	-0.00	19.47	-0.00	19.93
	(0.03)	(57.49)	(0.03)	(57.24)	(0.03)	(57.34)	(0.03)	(57.19)
Observations	4,612	4,612	4,612	4,612	4,612	4,612	4,612	4,612
R-squared	0.073	0.058	0.064	0.030	0.071	0.058	0.069	0.042

Notes: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Standard errors are reported in parentheses.
Woman specific control variables: age at marriage, age, age square, average district level ln wage rate, marital status (married versus divorced and widowed), urban place of residence, childhood place of residence if urban, educational attainments: primary, secondary, post-secondary graduation and no education is base category, caste: Hindu Brahmin, Hindu Forward class, SC and ST, Muslim, Christian and others and OBC is considered as base category, land (unearned wealth) and the regions of India: Northern, North-Eastern, Central, Eastern, Western. First stage regression results are presented in Appendix Table A3.39.
Source: Estimates are based on author's own calculation using the IHDS-II dataset.

We will now look at the final sample of women with school-aged children residing in extended family settings. Table 3.11 reveals that in an extended family setting, school-aged children do not affect female labour market outcomes; however, the wage rate continues to encourage female participation in the labour market and working longer hours in the market.

The table further shows that, for a woman with school-aged children, a 1% increase in the wage rate increases female labour market participation by 0.37 of a percentage point, and it increases the annual labour supply by 11 hours on average. The results are statistically significant at the 1% level.

The magnitude of the impacts of wage rate on female supply market outcomes are higher in a nuclear family setting (see Table 3.10) than in an extended family setting. The empirical evidences in this study thus show that women is nuclear families with school-aged children are likely to respond more to market wage rates to supplement economic needs of their families compared to those in extended family settings where women receive benefits from other working members.

For a woman with school-aged children, in an extended family setting, the ownership of land as wealth reduces women's annual labour supply by 224 hours on average (see third column of Table 3.12). The result is statistically significant at the 1% level. The empirical findings reveal that the magnitude of the negative effect of wealth on female supply hours are higher in an extended family setting (see Table 3.12) than in nuclear family setting (see Table 3.10), as it should be expected due to joint effort that are more likely from other male family members.

Table 3.12: 2SLS: Effect of school-aged children on female labour market outcomes in the extended family setting

Mother Age 18-54	LPM Part.	OLS Hours	2SLS Twins Part.	2SLS Twins Hours	2SLS FG Part.	2SLS Twins & FG Hours	2SLS FG Part.	2SLS Twins & FG Hours
Main variable:								
No. of children	-0.01	-10.13	0.04	113.23	0.03	105.40	0.04	108.43
	(0.01)	(12.26)	(0.06)	(125.75)	(0.05)	(87.84)	(0.04)	(74.97)
Economic variables:								
Log wage rate	0.37***	1057.27***	0.73***	1205.72***	0.72***	1196.30***	0.72***	1199.94***
	(0.09)	(197.75)	(0.13)	(252.65)	(0.13)	(225.58)	(0.12)	(219.82)
Land ownership (0/1)	-0.01	-224.37***	-0.10***	-225.07***	-0.10***	-225.03***	-0.10***	-225.04***
	(0.01)	(31.18)	(0.02)	(31.41)	(0.02)	(31.35)	(0.02)	(31.37)
Demographic variables:								
Age at marriage	-0.00*	-2.78	-0.00	3.08	-0.00	2.71	-0.00	2.85
	(0.00)	(3.88)	(0.00)	(7.10)	(0.00)	(5.61)	(0.00)	(5.20)
Age of mother	0.01	49.81***	0.01	10.19	0.01	12.70	0.01	11.73
	(0.01)	(17.08)	(0.02)	(43.08)	(0.02)	(33.18)	(0.02)	(29.21)
Age mother square	-0.00	-0.62***	-0.00	-0.10	-0.00	-0.13	-0.00	-0.12
	(0.00)	(0.23)	(0.00)	(0.57)	(0.00)	(0.44)	(0.00)	(0.39)
Married	-0.21***	-470.81***	-0.22***	-518.04***	-0.21***	-515.05***	-0.21***	-516.21***
	(0.05)	(67.89)	(0.04)	(83.21)	(0.04)	(77.13)	(0.03)	(74.57)
Urban	-0.04***	-139.60***	-0.13***	-134.38***	-0.13***	-134.71***	-0.13***	-134.58***
	(0.01)	(34.07)	(0.02)	(34.62)	(0.02)	(34.48)	(0.02)	(34.40)
Childhood in urban	-0.01	-12.68	-0.01	-15.49	-0.01	-15.31	-0.01	-15.38
	(0.01)	(30.38)	(0.02)	(30.59)	(0.02)	(30.29)	(0.02)	(30.36)
Primary	-0.01	-91.96***	-0.09***	-84.30**	-0.09***	-84.78**	-0.09***	-84.60**
	(0.02)	(34.36)	(0.02)	(35.24)	(0.02)	(35.26)	(0.02)	(34.97)
Secondary	-0.08***	-232.10***	-0.18***	-210.12***	-0.18***	-211.51***	-0.18***	-210.97***
	(0.01)	(29.75)	(0.02)	(36.63)	(0.02)	(33.18)	(0.02)	(32.06)
Post sec. education	-0.10***	-28.49	-0.12***	13.91	-0.12***	11.22	-0.12***	12.26
	(0.02)	(54.88)	(0.03)	(69.80)	(0.03)	(61.77)	(0.03)	(60.05)
Graduate education	0.00	220.00***	0.01	263.25***	0.00	260.51***	0.01	261.57***
	(0.02)	(69.48)	(0.04)	(82.11)	(0.04)	(76.31)	(0.04)	(74.40)
Brahmin	-0.03	-124.89***	-0.10***	-118.90***	-0.10***	-119.28***	-0.10***	-119.13***
	(0.02)	(43.05)	(0.02)	(44.00)	(0.02)	(43.92)	(0.02)	(43.81)
Forward	-0.00	-75.28**	-0.07***	-57.65*	-0.07***	-58.77*	-0.07***	-58.33*
	(0.01)	(30.32)	(0.02)	(34.91)	(0.02)	(33.19)	(0.02)	(32.25)
SC and ST	0.07***	169.88***	0.12***	158.77***	0.13***	159.47***	0.13***	159.20***
	(0.01)	(30.56)	(0.02)	(32.50)	(0.02)	(31.42)	(0.02)	(31.17)
Muslim	-0.05***	-106.44**	-0.12***	-151.50**	-0.11***	-148.64***	-0.11***	-149.74***
	(0.01)	(41.70)	(0.03)	(62.80)	(0.03)	(53.35)	(0.03)	(50.72)
Christian and others	-0.00	-102.83	-0.10***	-88.42	-0.10***	-89.33	-0.10***	-88.98
	(0.03)	(66.74)	(0.03)	(67.99)	(0.03)	(67.43)	(0.03)	(67.12)
Observations	4,612	4,155	4,155	4,155	4,155	4,155	4,155	4,155
R-squared	0.172	0.141	0.166	0.123	0.169	0.125	0.168	0.124

Notes: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Standard errors are reported in parentheses.
Woman specific control variables: age at marriage, age, age square, average district level ln wage rate, marital status (married versus divorced or widowed), urban place of residence, childhood place of residence if urban, educational attainments: primary, secondary, post-secondary graduation and no education is base category, caste: Hindu Brahmin, Hindu Forward class, SC and ST, Muslim, Christian and others and OBC is considered as base category, land (unearned wealth) and the regions of India: Northern, North-Eastern, Central, Eastern, Western. First stage regression results are presented in Appendix Table A3.39.
Source: Estimates are based on author's own calculation using the IHDS-II dataset.

3.7. Discussion and conclusions

Studies in the past have examined the impact of fertility on female labour market outcomes in both developed and developing countries. Some of these studies have also investigated how wage rate and unearned family income influence female time-allocation in different activities, such as housework, market-work and leisure. This broad division of time into the three types of regular activities is known as the trichotomy of time allocation in the labour economics literature. Theoretical study based on the trichotomy of time allocation by married women has been motivated by Gronau (1977).

Gronau assumes that in a developed country setting, a woman may choose to spend *zero* hours at home and may allocate her total time between market-work and leisure. To reflect a more realistic context, I assume that a woman spares some compulsory minimum amount of time at home such that hours spent at home is strictly positive, instead of a *zero* possibility. Therefore, I have redefined the equilibrium time-allocation as house-work time (which is strictly positive hours and it is made possible by introduction of an additional time-constraint, *compulsory house-work time requirement*, into the original Gronau framework), market-work time and leisure time. Under this amendment, I show how the optimal hours of labour supply in the market may decline below Gronau-equilibrium hours of labour supply. I further show that, depending on the relative magnitude of a shift in the additional time-constraint from its reference point due to an exogenous fertility shock, there could be a possibility of a *sub-optimal* solution that may cause a working woman to exit the labour market or an optimal solution with a decline in the labour market time. In the theoretical models, I demonstrate the direction (not the magnitude) of change in the hours of labour supply due to the fertility shock.

Following this theoretical demonstration, I empirically test whether the exogenous fertility shock (i.e., having a young child below the age of six) has negative impacts on female labour market outcomes.

Due to the endogenous nature of fertility I instrument fertility using *twins* (i.e., whether or not a mother has twins) for a causal analysis. I also use an alternative instrument: *first-born girl* (i.e., whether or not the first-born child is a girl). This is the first study in India that examines the causal impact of fertility on female labour market outcomes

Using the IHDS-II dataset and twins as instruments for fertility, I find an additional young child (below the age of six) reduces the probability of female labour market participation by 11 percentage point on average, while it reduces the annual labour supply by 200 hours on average. The negative impact of young children on female labour market participation is evident in the urban area and in the nuclear family setting. The negative impact of young children on hours of work in the market is relevant to both the types of settlement (urban and rural) and to both the types of family setting (extended and nuclear). In contrast, school-aged child, on average, increases the chances of female labour market participation by four percentage points, although they have null effect on women's average hours of labour supply. In contrast, school-aged child, on average, increases the chances of female labour market participation by four percentage points although they have null effect on women's average hours of labour supply.

The economic variables, such as wage rate and unearned family wealth are the key features of the theoretical model as wage rate captures the opportunity cost of engaging in domestic household production activity by the woman. Therefore, it is relevant to comment on the impacts of the wage rate on female labour market outcomes. The findings in this study reveal that hourly wage encourages female labour market participation and work for longer hours in the market, but it has null effect for those women who are residing in the nuclear family setting and have young children. In contrast, family wealth restrains women from the labour market participation and working longer hours in the market. These findings are consistent with the theoretical predictions of Blundell and MaCurdy (1999), which are typically relevant for a developed country context.

From a policy perspective, although the related studies in the literature have emphasised the need to increase employment opportunities for females in the face of a rising number of highly educated women in both urban and rural areas (Klasen and Pieters, 2015; Sarkar et al., 2019; Afridi et al., 2018), the principal findings in this study suggest that the female labour market outcomes (i.e., participation and hours of labour supply) are sensitive to the age categories of children (i.e., 0–5 and 6–17), hourly regional wages, unearned family wealth and other demographic factors, such as women's age, education, caste etc.

The average hourly wage in India is very low. The recent GOI (2019) annual report on periodic labour force survey reveals that, during 2017-18, females have worked for 52 (50) hours on average on a weekly basis in urban (rural) areas as regular wage or salaried employees. As casual labourers, they have worked for 42 (39) hours per week in urban (rural) areas. As self-employees, they have worked for 42 (40) hours per week in urban (rural) areas. The average monthly earnings for female regular wage or salaried employees is Rs. 14,487 (Rs. 9,895) in urban (rural) areas. Therefore, higher wage incentives may be considered as one of the crucial elements in the future policy agenda to encourage female labour market participation in India.

Regarding the need to increase the wage rate for women, Afridi et al. (2018) have emphasised that even when women achieve a higher educational qualification, if the returns to women's home production are greater than the returns in the labour market, women are likely to withdraw from the labour force and engage in domestic work. However, an empirical measurement of returns to women's home production may be challenging; it requires further research.

Cultural practices also play an important role in female labour market participation decisions. For example, there is a common conservative attitude among people that married women working with men outside the household is frowned upon, even in contemporary Indian society (Eswaran et al., 2013). Therefore, women are not allowed to participate in the labour market unless there is a need to augment economic-status of a family. This could be one of the major causes behind low female participation in the Indian labour market.

In addition to the need to expand employment opportunities through a policy such as the National Rural Employment Guarantee Act of 2005 (guaranteeing at least 100 days of work to all) and to provide higher wage incentives to wage or salaried employees and casual labourers, there is a need to improve the quality of childcare facilities. The empirical findings in this paper reveal that fertility restrains female labour market participation when children are young. A woman who is employed could face conflict between her roles as a mother and a worker, especially when her children are young (i.e., below the age of six). This conflict could be severe in the absence of an affordable and a qualitative childcare provision. This may inevitably encourage a woman to choose the mother role at the cost of a worker role. Availability of a poor-quality childcare facility is not only a concern in a developing country like India but is also a concern for a developed country like Quebec (Baker et al., 2019). Therefore, there is a need to expand childcare provisions in India, not only in terms of its affordability but also in terms of its quality, to encourage more female participation in the labour market. However, improving the quality of childcare facilities may require a large public investment. Singh and Masters (2017) perform an experimental study in Chandigarh, India to show that incentives in the form of performance pay and bonuses to government childcare workers could be an effective tool in improving childcare quality. Whether such an investment would be cost effective at the national level requires further research.

There are some limitations of this study. The study focuses solely on those women who are working in paid jobs outside home. However, there are many unpaid work that women routinely do at home in family enterprises. By engaging in these activities, women indirectly contributes to economic activity. However, it is not feasible to provide empirical insights for this set of women due to data limitation. In addition, the study uses two alternative instruments. Using first born girl as instrument, the study finds null impact of fertility on female labour market outcomes. These results are, therefore, different from what is observed using twins. This difference is due to a local average treatment effect pertaining to a chosen instrument.

As an agenda for further research, this analysis could be extended to understand the impact of fertility on the *trichotomy of time allocation* by women in a developing country context. Such a study would require precise information on time spent by women on at least three of the core activities namely, housework, market work and leisure (if sleep-time is excluded from the leisure time). This would be similar to what Gronau has done in the developed country context, such as in Israel and in the USA. In addition, complete information on husbands' labour market outcomes could make the study even more interesting as this will enable the comparison of labour market outcomes by gender, as motivated by Becker (1985).

Chapter 4. The Impact of Caste Certificates on Standard of Living: Evidence from Indian Slums

(with Sugata Bag and Suman Seth)

4.1. Introduction

Affirmative Action is variously known as positive-, protective- or compensatory-discrimination and its variants have been pursued in different countries, such as India, South Africa, Brazil, Northern Ireland, Malaysia and the United States (Darity et al., 2011) to combat social discrimination in the form of caste, race, ethnicity or religion. In the early twentieth century, practice of untouchability, that has been seen as a major social disability in India, has arisen out of the caste system. Consequently, reservation was introduced in administrative positions since the first quarter of twentieth century by the princely states in India, such as Baroda, Kolhapur and Travancore, for the socially disadvantaged group of people (see Deshpande, 2013, Chapter 2, p.46). Reservation is seen as the core of India's Affirmative Action (AA) Programme and is primarily caste based.

The need of AA Programme divides the entire Indian population in the available national data (such as the National Sample Survey (NSS)) into four broad groups (see Deshpande, 2013, Chapter 1, p.18): (i) Schedule Caste (SC: who are known as ex-untouchable jatis and several members of this jati self-identify themselves as 'Dalit'), (ii) Schedule Tribe (ST: This group mostly comprises of tribal people, but more specifically geographically isolated groups of people. So, some non-tribal people are also included in this category, particularly those residing in the hills (includes 'Himachali Brahmins')), (iii) Other Backward Class (OBC: a heterogenous collection of Hindu low caste, some non-Hindu communities, and some tribal people who are not included in ST category), (iv) Others or General (the residual of the population that is further divided into two groups: Brahmins and Forward Class (includes all religions)).

In 1950, for the upliftment of SC and ST groups, Article 46, under the Directive Principles of State Policy, the Constitution of India pronounced that the state shall promote, with special care, the educational and economic interests of the weaker sections of the people and protect them from social injustice and all forms of exploitation. For the identification of OBC people, the Mandal Commission was set up in 1978. OBCs have finally obtained a legal recognition through Supreme Court order of 1995. Subsequently, implementation of OBC reservation for government job has been initiated in 1998 and it has been extended for education in 2006. In this study, we focus on SC/ST and OBC eligible groups of households that qualify for reservation benefits.[50] The terms *eligible* and *disadvantaged* group are used interchangeably.

Even in the 2000s, the disadvantaged groups often trail behind in various socio-economic outcomes, namely consumption, education, health and employment. Let us first look at one of these aspects, namely consumption expenditure across all social groups (see Table 4.1). The monthly per capita consumption expenditure (MPCE) data are collected from the recent national sample survey (NSS, 2015). MPCE continued to remain lower for SC, ST and OBC groups compared to General group in both rural and urban areas and in both the periods 2004–05 and 2011–12.

[50] The list of candidates who are scheduled as disadvantaged groups in the Constitution of India are *eligible* groups. It is to be noted that among OBC groups, there is a 'creamy layer' OBC group of people who have better economic conditions and are not eligible for government-sponsored educational and professional benefit programmes that are implemented for disadvantaged groups.

Table 4.1: Monthly per capita consumption expenditure by the caste categories

		ST	**SC**	**OBC**	**General**	**All**
		2004–05				
Rural	Population share (by column)	91.40	79.80	78.00	62.30	74.40
	Average MPCE (in INR)^2	426.19	474.72	556.72	685.31	558.78
	Poverty Rate	-	53.50	39.80	27.10	41.80
Urban	Population share (by column)	8.60	20.20	22.00	37.70	25.30
	Average MPCE (in INR)^2	857.46	758.38	870.93	1306.10	1052.36
	Poverty Rate	-	40.60	30.60	16.10	25.70
		2011–12				
Rural	Population share (by column)	89.00	80.00	75.00	60.00	72.96
	Average MPCE (in INR)^2	1,122	1,252	1,439	1,719	1,430
	Poverty Rate	-	31.50	22.60	15.30	25.70
Urban	Population share (by column)	11.00	20.00	25.00	40.00	27.04
	Average MPCE (in INR)^2	2,193	2,028	2,275	3,242	2,630
	Poverty Rate	-	21.70	15.40	8.20	13.70

Notes: [1]Monthly per capita consumption expenditure (MPCE).
Source: Adopted from NSS (2007) and NSS (2015)

A graphical illustration of MPCE of the caste groups in different deciles is presented in Appendix Figure A4.1. Here we divide the entire (urban and rural) population into ten equal groups (i.e., decile) of MPCE, such that each decile contains 10% of the sample population. The first decile forms the poorest group in terms of MPCE, whereas the tenth decile forms the richest group. Then for each social group (i.e., SC, ST, OBC and Others/General), the distribution of the sample population is computed across these ten deciles. The distributions of population within different social groups across deciles of MPCE are presented in Appendix Figure A4.1. The figure reveals that, compared to the rest of the Indian population, ST, SC and OBC are more likely to fall in the poorer deciles of MPCE distributions within both rural and urban areas. In addition, the GOI (2016) reports that the poverty rate continued to remain higher within SC, ST and OBC groups than within the General group (see Table 4.1). The study by Howard and Prakash (2012) reveals that in 1999-2000, the proportion of SC people living below the poverty line has been 45.9% in rural areas and 38.3% in urban areas, while it has been 36.2% in rural areas and 35.6% in urban areas for ST. SC and ST also suffer from deprivation in many other spheres; for example, the infant mortality rate for SC and ST is 109 per 1,000, while it is 54 per 1,000 for non-minorities. Zacharias and Vakulabharanam (2011) discuss the existing wealth inequality between the disadvantaged and the non-disadvantaged groups in India. Not only are disadvantaged groups left behind in the monetary measure of living standard, they are also lagging behind in several non-monetary aspects of living standard, including schooling, mortality, nutrition, access to electricity, sanitation, water, housing, cooking fuel and asset ownership (Alkire and Seth, 2015; Alkire et al., 2018). These recent studies confirm that the difference in the standard of living, measured by monetary (i.e., MPCE) and non-monetary measures, continues to exist between the disadvantaged and the General groups. Deshpande and Ramachandran (2019), in their recent study, observe that the difference in wages between *eligible* groups and the rest of the population above median wage has in fact diverged over time.

In order to improve the standard of living of *eligible* groups and bring them to a level playing field with the rest of the population, the Indian government has undertaken compensatory discrimination measures; these include the reservation of places in higher education, central and state government jobs and political arena. There have been many research studies delving into the effect of these compensatory discrimination measures on education, employment, earnings and political representation of *eligible* groups.[51] While some of these studies find positive impacts of these measures, others find null impact. For example, Chin and Prakash (2011) and Kaletski and Prakash (2016) find that reservations for ST significantly reduce their poverty and the incidence of child labour respectively.

However, *eligible* groups are not automatically entitled to the benefits offered through AA Programme. To avail the reservation benefit, an eligible beneficiary must possess a valid

[51] See, for example, Pande (2003a), Banerjee and Somanathan (2007), Bertrand et al. (2010), Chin and Prakash (2011), Howard and Prakash (2012), Deshpande and Weisskopf (2014), Kaletski and Prakash (2016), Kaletski and Prakash (2017), Girard (2018) and Deshpande and Ramachandran (2019).

caste certificate issued by the state government of his/her state of origin.[52,53] Therefore, one needs to register for a caste certificate only if s/he wants to avail the reservation channel. Hence, registration for a caste certificate is a choice and therefore it is endogenous. Even after registering for a valid caste certificate within the beneficiary's state of origin, it is possible that an *eligible* beneficiary is deprived of the mandated benefits if s/he does not reside in his/her state of origin. This particular problem becomes even more relevant for those *eligible* beneficiaries who are required to relocate (i.e., migrate) outside their state of origin.

Thus, a question that naturally follows is, whether the possession of a valid caste certificate by the *eligible* groups has any relevance towards improvement in their living standard compared to similar *eligible* households that do not possess one. This is a primary question for investigation in this chapter.

Given that the registration for a caste certificate by an *eligible* beneficiary is driven by the beneficiary's choice, we therefore use an instrumental variable (IV) approach to control for the endogeneity. We, exploit the available information on *whether an eligible household is residing in its state of origin* to instrument for the caste certificate possession. The reason for considering the *state of origin* as an instrument is as follows. Registration for caste certificate can only be done in the state of origin where a parental property (such as parental house) is located because the official verification is done in that property. Thus, residing in a state where parental property is located makes it economical (i.e., in term of time and effort), given the bureaucratic government procedures followed at the local levels during the registration process. Consequently, residing in the *state of origin* increases the chance of possessing of a valid caste certificate. In addition, residing in one's ancestral state of origin is unlikely to be influence by unobserved choices of an individual, especially when people are living in their

[52] See Clause 2 of document number 35/1/72-R.U. (SCT.V) dated 2nd May 1975 issued by the Ministry of Home Affairs of the Government of India. Available at http://socialjustice.nic.in/writereaddata/UploadFile/guide-certificate636017830879050722.pdf (accessed in December 2019).

[53] In contrast, to avail of the benefits offered by the national (i.e., the central) government, a beneficiary's caste must be listed in the national (i.e., the central) government's list of *eligible* castes. In this case, the beneficiary does not need to re-register their caste certificate for working in central government jobs during their migration to a new city in a different state.

ancestral states for generations. Furthermore, the instrument controls for the possibility of holding a valid caste certificate, which cannot be directly known from the dataset.[54]

To investigate the primary research question in this study, i.e., whether the *eligible* households have better standard of living for possessing a caste certificate compared to similar *eligible* households that do not possess one, we focus on the *eligible* households that reside in the urban slums of two Indian metro cities: Kolkata (a city in the state of West Bengal) and Mumbai (a city in the state of Maharashtra). The 2011 Census report reveals that, with India's rapid economic growth, the slums of these two metro cities have witnessed an inevitable influx of poor migrants. These two cities, among all Indian cities, have the largest shares of population residing in slums: 41.8% and 31.4% in the municipal corporations of Greater Mumbai and Kolkata respectively.[55] Our focus on slum households is of interest for two key reasons. First, the poorest sections of the Indian population are historically understudied. Bertrand et al. (2010) have emphasised that the impacts of reservation policies are usually beneficial to those that are from relatively richer backgrounds within disadvantaged groups, while those from poorer backgrounds within disadvantaged groups are deprived of the positive impacts. Second, many poor migrants who relocate to the city slums of Kolkata and Mumbai from other states, either do not possess caste certificates or are unable to use their caste certificates (issued by the state governments of their *states of origin*) in migrating states.

The percentage of *eligible* households possessing a caste certificate in our sample is presented in Table 4.2 below. Within the sample of SC/ST households 53% of the households have caste certificates while it is 42% within OBC households.

[54] A valid certificate means a caste certificate that can be used only if it is registered within a state of origin. We acknowledge that during the survey it has not been asked whether the households have caste certificates registered within the state of residence. This is clearly something that requires investigation as part of an agenda for future research.

[55] The figures on the shares of slum populations for Mumbai and Kolkata have been collected in December 2019 from the Census 2011 websites, https://www.census2011.co.in/census/city/365-mumbai.html and https://www.census2011.co.in/census/city/215-kolkata.html, respectively. Total slum dwelling populations in Greater Mumbai and Kolkata in 2011 have been 5.2 million and 1.4 million, respectively.

Table 4.2: Caste certificate holding status by the *eligible* and the *non-eligible* households

	No. of Households without caste certificate	No. of Households with caste certificate	*Eligible* Sample	Total Sample
Non-*eligible* sample:				
General households	666			**666**
				[49.2]
Eligible SC/ST households	193	219	**412**	**412**
Share of CC status (by column)	(54.67)	(65.56)	(59.97)	[30.5]
Rate of CC status (by row)	⟨46.84⟩	⟨53.16⟩	⟨100⟩	
Eligible OBC households	160	115	**275**	**275**
Share of CC status (by column)	(45.33)	(34.43)	(40.03)	[20.3]
Rate of CC status (by row)	⟨58.18⟩	⟨41.82⟩	⟨100⟩	
Eligible Sample	353	334	**687**	
	(100)	(100)	(100)	
Overall rate of CC status for all eligible households	{51.38}	{48.62}	{100.00}	
Total Sample	1,019	334	687	**1,353**
				[100]

Notes: This tables provides information on the proportion of *non-eligible* (i.e., General) and *eligible* households in the sample under study. It also provided information on the share of caste certificate holding across and within the eligible household.
Figures in parentheses are shares of caste certificates (holding or non-holding) across *eligible* households (by columns).
Figures in angular brackets are shares of caste certificate (holding or non-holding) within caste groups (by row).
Figures in curly brackets are shares of caste certificate holding across caste groups.
Source: Estimates are based on authors' own computations using own survey data.

To measure the standard of living of slum dwelling households, we use a composite measure; we refer to this as the multidimensional index of attainment (MIA), consisting of ten attainment indicators.[56] The MIA score for each household ranges between *zero* and *one*. A larger MIA score represents a higher standard of living. The average MIA score for all *eligible* households is 0.54, while it is 0.60 for OBC households and 0.50 for SC/ST households (see Table 4.6).

Using an IV approach, the primary findings in this study reveal that, on average, a one percentage point increase in the caste certificate rate increases the MIA score for OBC households by 0.0017 of a unit. To understand the mechanism for such positive impact of a caste certificate on the living standards of *eligible* households, we explore whether the procure-

[56]MIA is based on the well-known counting approach framework (Atkinson, 2003; Alkire and Foster, 2011).

ment of government job by household members could be an explanatory channel. It is already known from the literature that the cornerstone of AA schemes have been to provide representation of *eligible* groups through reservation, such as in government jobs (Bertrand et al., 2010; Kumar et al., 2019; Deshpande and Ramachandran, 2019). The procurement of government jobs has it own positive impact on the standard of living of disadvantaged groups (Thorat et al., 2016). We therefore investigate whether government job holdings could mediate the positive impact of caste certificates on the living standards of slum-households. Our findings reveal that, on average, a one percentage point increase in the caste certificate rate increases the chance of holding a government job by 0.24 of a percentage point for all *eligible* households and 0.39 of a percentage point for OBC households. Consequently, on average, a one percentage point increase in the government job rate increases the MIA score for all *eligible* households by 0.12 of a unit and for OBC households by 0.11 of a unit.

The rest of the chapter is organised as follows. Section 4.2 discusses the background of the Indian caste system, the studies that motivate this research and contribution to the literature. Section 4.3 describes our data and provides the relevant descriptive statistics. Section 4.4 discusses the empirical strategy and identification. Section 4.5 presents the main results. Finally, Section 4.6 discusses the key findings, caveats of the study and concludes with policy implications and avenues for future research.

4.2. Contextual background

Historical systems of social stratification by caste in India and race or ethnicity in the United States and Africa has remained a marker of identity in contemporary societies (Deshpande and Ramachandran, 2019). Discrimination in various aspects of life continues to exist either in the form of colour or creed within both developing and developed countries. For example, the study by Bertrand and Mullainathan (2004) reveals racial discrimination in the USA labour market where white names receive higher callbacks from the USA labour market than

African-American names. Similarly, in the context of the USA, Alesina et al. (1999) study that high levels of ethnic diversity are associated with 25% lower local funding for schools and other public goods in the municipalities. Lee (2012) studies that the affirmative action targeted towards the Bumiputera (a disadvantaged group) in Malaysia increases their representation in tertiary education (i.e., graduate education), although this predominantly occurs in low quality and less regarded public institutions. In recent years, sub-Saharan Africa, which is the most ethnically diverse and the poorest region of the world, has experienced a series of destructive ethnic conflicts. Such ethnic diversities and continuous conflicts have affected public-school funding at primary level (Miguel, 2000). In terms of social class conflicts, India is not the exception.

4.2.1. Caste system in India

In India, social discrimination exists in the form of differences across castes (or jatis) and religions. Caste system in India has two distinct concepts–the varna system (that divided the ancient Hindu society) and the jati system (that determines the contemporary social code).

In its ancient manifestation, the varna system is roughly 2,500 years old (see Deshpande, 2013, Chapter 1, p.11) and this system has divided the ancient Hindu society into four distinct varnas that are mutually exclusive, hereditary, endogamous and occupation specific (see Deshpande, 2011, Chapter 2, p.19): Brahmin (i.e, priests and teachers), Kshatryia (i.e., kings and warriors), Vaisya (i.e., traders, merchants, moneylenders) and Shudra (those engages in menial, lowly jobs).

Outside the varna system were those that used to do most despicable menial jobs. Today they are called Atishudra or the former 'untouchables'. This is because they were considered unfit in the past for even to be given a varna. Hence, the Atishudras (i.e. ex-untouchables) are also called Avarnas and are excluded from the varna system. Such a practice of 'untouchability' had existed since 1020 AD. Over time, as the economy grew more complex, and as new castes emerged through fission, fusion, intermarriage, migration, and through the emergence of new occupations, the historical varna system gets transformed into the contemporary jati system, which is essentially a system of regional caste grouping. Although the jati system shares many similarities with the varna system, it is not a clear subset of varnas. Under each caste category there are several jatis. In the contemporary society, the exact number of jati is not known with certainty but the count is close to 7,000 communities with a wide variation in size; while some communities have more than a million members, others have less than 1,000 members (see Deshpande, 2013, Chapter 1, p.12).

Just as the varna-jati link is not strictly defined (although, contemporary jatis try to align themselves with the varna scale), except at the top and bottom of the system, the jati-occupation link is less straight forward than the ancient varna-occupation link (Deshpande, 2013). The contemporary jati system should be understood as a system of graded inequality rather than a simple dichotomous hierarchy between upper castes and lower castes. This is because the caste system has not remained static: migration, emulation, isolation, segregation, occupational specialization, conversion, and incorporation of tribal groups have resulted in a change in the relative standing of the contemporary jatis. There has been a significant shift from the traditional jati occupations which has lead to improvement of jatis' economic condition but the existing caste system has continued to shape social and religious practices. Today, the varna symbolises status scale; while jatis try to align themselves with the varna scale although they follow a very complex system of hierarchy and rules of conduct towards each other in the contemporary India (Deshpande, 2011).

In the early twentieth century, the practice of untouchability was seen as a major social disability arising out of caste system. Therefore, in the first quarter of twentieth century reservation was introduced for the disadvantaged groups of people in administrative positions. Reservation is considered as the core of India's Affirmative Action (AA) Programme, which is viewed as a compensatory discrimination measure and is primarily caste based.

The need of AA Programme divides the entire Indian population in the available national data (such as the National Sample Survey (NSS)) into four broad groups: (i) Schedule Caste (SC: who are known as ex-untouchable jatis and several members of this jati self-identify themselves as ‘Dalit’ and are also called avarnas), (ii) Schedule Tribe (ST: This group mostly comprises of tribal people, but more specifically geographically isolated groups of people. So, some non-tribal people are also included in this category, particularly those residing in the hills (includes ‘Himachali Brahmins’)), (iii) Other Backward Class (OBC: a heterogenous collection of Hindu low caste, some non-Hindu communities, and some tribal people who are not included in ST category), (iv) Others or General (the residual of the population that is further divided into two groups: Brahmins and Forward Class (includes all religions)). Today’s Brahmins can be aligned to Brahmin scale in the varna system while OBCs can be aligned to Shudra scale in the varna system.

In 1950, Article 46, under the Directive Principles of State Policy, the Constitution of India pronounced that the state shall promote, with special care, the educational and economic interests of the weaker sections of the people (particularly, SC and ST) and protect them from social injustice and all forms of exploitation. For the identification of OBC people, the Mandal Commission was set up in 1978. OBCs have finally obtained a legal recognition through Supreme Court order of 1995. Subsequently, implementation of OBC reservation for government job has been initiated in 1998 and it has been extended for education in 2006. Therefore, the *eligible* group of people who qualify for reservation benefits are SC/ST and OBC. The list of eligibility criteria for SC, ST and OBC are defined in government schedule since 1936. The list reflected a combination of economic and educational criteria to determine untouchability. In addition, territory and religion are two other factors that were proposed to be included for identification of SCs (Deshpande, 2013). The designation of a group as ST has been much less controversial than the designation of SC and OBC. The criteria for ST are supposed to include all tribal characteristics, such as social, religious, linguistic and cultural distinctiveness, who are spatially and culturally isolated from the mainstream. However, the demarcation of tribals and non-tribals is not unambiguous. Indeed during the 1950s, some groups which were earlier classified as SCs were reclassified as STs. The formal mechanism of being listed as a ST is the same as for SCs. After SCs were listed as a separate category, the term backward classes started being used in two senses: as a group of all communities which needed preferential treatment and as a caste low in socio-economic hierarchy but not as low as untouchables (presumably the erstwhile Shudras). The exact identification of groups and communities which should be counted as OBCs has been fraught with a great deal of controversy. The final agreement on the identification of backward class had been designated at the local levels (Deshpande, 2013).

4.2.2. Literature review

While the disparity between the disadvantaged category and the General category has continued to remain static in some welfare dimensions, it has diverged in many other welfare dimensions (NSS, 2015, 2007; Zacharias and Vakulabharanam, 2011; Alkire and Seth, 2015; Alkire et al., 2018). Within the political sphere, over the last two decades, there has been a gradual transformation where the lower caste groups have acquired a greater say because of their electoral representation through *quotas* in local elections. However, the absolute gaps in the years of schooling and high-skilled jobs have remained static across *eligible* and General groups. In addition, the difference in wages, between *eligible* and General groups, above the median wage has diverged over time (Deshpande and Ramachandran, 2019).

In order to improve the standard of living of *eligible* groups and bring them to a level playing field with the rest of the population, the Indian government has undertaken compensatory discrimination measures; these include the reservation of places in higher education, central and state government jobs and political arena. The benefits of such reservation in India on several dimensions of well-being have been examined in a number of studies. For example, Howard and Prakash (2012) study the impact of employment *quotas* on occupational choices of disadvantaged groups. By exploiting an exogenous variation in the *quota* they find that SC groups are more likely to choose high-skilled occupations, while ST groups are more likely to choose low-skilled occupations.[57] The identification of minority reservation using *quota* system (following Prakash (2009)) is also exploited by Chin and Prakash (2011) to examine its impact on poverty reduction.[58] Using the NSS and census data from 1951–2001, they find that SC reservation has no impact on the incidence of poverty in rural areas but ST reservation has negative and significant impact on poverty. In terms of intensity of poverty, in both urban and rural areas, ST reservation reduces both the depth and severity of poverty.

These findings reveal that affirmative action policies are accompanied by substantial inter-caste disparities, albeit its impacts are mixed. Such inter-caste disparity is also revealed in the study by Banerjee and Somanathan (2007). They have used two years of panel data for rural India from the census years 1971 and 1991 to study how public goods get allocated by a centralised state. Using 15 indicators for public goods, they find that SC groups benefit from access to public goods while ST groups experience a decline in the access to public goods. This is because SC groups formed their own political party, the Bahujan Samaj Party (i.e., BSP which exists in the cow belt of North India i.e., in Uttar Pradesh, Madhya Pradesh, Rajasthan, Punjab, Haryana), in the mid-1980s, while ST groups had limited political success.

Several other studies have examined the impacts of affirmative actions on various outcomes. For example, Kaletski and Prakash (2016) find such policies reduce incidence of child labour for ST groups. While Deshpande and Weisskopf (2014) find a higher proportion of SC and ST employees have positively contributed to an increase in productivity in the Indian railways.

[57] Prakash (2009) explains the identification of *quota* as follows: in each state, the percentage of employment quota for each minority group is constructed using the minority share of respective state's total population taken from the recent census of population. This policy rule, which is set by the Constitution of India, incorporates a lag in revision of the share of respective state's total population in census because this revision undergoes a complex administrative procedure. Therefore, due to the lag in revision, this policy rule generates an exogenous variation in public sector *quota* at the state level and permits identification of the effect of quotas on government sector employments.

[58] Poverty is measured using three measures. First, incidence of poverty is measured by the headcount ratio, defined as the proportion of people below the poverty line. Second, the intensity of poverty is measured by the poverty gap index. Third, squared poverty gap index is a variant of the poverty gap index that gives more weight to the poor.

Girard (2018) finds such policies reduce street exclusions for SC. She examines whether affirmative action in the form of quotas affects caste-based discrimination. Discrimination is measured in terms of street exclusion, which is a dummy variable: equal to *one* if the household head in village declares to have been excluded from streets during the year, *zero* otherwise. Using the Rural Economic and Development Survey (REDS) dataset and linear probability model, the result shows that, in 2006, SC households living in a village with an SC quota have been 10 percentage points less likely to suffer from caste-based discrimination; this is statistically significant. The result is based on five Hindi belt states (i.e., Bihar, Haryana, Madhya Pradesh, Rajasthan and Uttar Pradesh). The result also reveals that the effect is not persistent: it disappears with the end of the SC quota.

The impact of affirmative action policy, in the form of *quota*, on several outcomes variables for SC and ST groups are therefore mixed. While all these studies have been conducted either at the national or state level, none have focused on the poorest sections of Indian society where the living conditions of disadvantaged groups are worst. For example, those who reside in the city slums of India. Bertrand et al. (2010) have emphasised that the impacts of *quotas* are effective in getting higher education and higher earnings from white-collar jobs when the disadvantaged groups are from relatively richer backgrounds. Those who are from poorer backgrounds are still deprived of the positive impacts of affirmative action policies.[59] Similarly, Pande (2003a) finds that the political representation of disadvantaged groups increases the welfare spending by government for disadvantaged groups, although the

[59] Bertrand et al. (2010) examine the causal impact of engineering degree (i.e., attending engineering college in 1996) on future earnings and job opportunities. The study explores different types of jobs, such as work as engineers, government jobs, private jobs and self-employed. OLS estimates suggest that there are positive and statistically significant earnings associated with attending engineering college for both upper and lower caste groups but the impact is larger for upper caste groups. The decision to attend engineering college may be influenced by unobserved preferences of the applicants which requires identification. The entrance exam score threshold (i.e., cut-off score) dummy for respective caste groups is used as an instrument for attending engineering college. The findings reveal that attending engineering college increases the likelihood of working as engineers for both upper and lower caste groups, but the likelihood is higher for the upper caste group than for lower caste group. They further examine whether family background affects the estimated future returns and find that the better-off lower-caste groups (as well as upper caste) benefited more from the affirmative action policy than worse-off lower caste groups.

study does not emphasise whether that government spending has direct impact on the living standard of disadvantaged households that belong to the economically poorest sections of society.

While none of the earlier studies have focused on the poorest section of society, to fill some of the gaps in the existing studies, we focus on some of the poorest sections of society i.e., exclusively on the urban slum households that are residing in the two metro cities in India, namely Mumbai and Kolkata. In our sample, we consider the *eligible* households and we examine whether the possession of a caste certificates has a relevance in improving a household's standard of living. We further investigate empirically whether holding a government job position could be the relevant channel for the observed outcome.

4.2.3. Contribution

First, we use uniquely collected datasets comprising of 1,361 households from the slums of Mumbai and Kolkata. We especially consider these two metro cities because they have witnessed the larger shares of population residing in slums among all other Indian cities. Using this dataset, we examine the impact of the possession of caste certificates on the living standard of urban slum-households. Such a slum-level study has never been done before.

Second, this is a novel study that examines a causal impact of caste certificate on the standard of living of the *eligible* slum households. Earlier studies have examined the impact of AA policy on various aspects of living, such as higher education, government job opportunities, welfare spending, child labour, public goods access, health provision, productivity and growth, political empowerment of women, discrimination, employment and poverty. However, getting adequately represented through *quota* system is outside the purview for slum households. Nevertheless, slum households can have access to low-skilled government jobs by using their caste certificates. Even though these jobs are low-skilled but having government job increases the certainty and predictability of income streams and thus reduces risk and uncertainty of losing the job or being low-paid which is common in private contractual menial jobs (Kumar et al., 2019). Using the same dataset, which used in this study, Bag and Seth (2017) have examined a possible correlation between caste certificate holding and the standard of living for slum-dwelling households while leaving a scope for a causal analysis in future.

Third, this study contributes to the literature a casual mediation analysis to investigate whether a positive impact of a caste certificate on a household's standard of living could be mediated through the procurement of government jobs by at least a member of the household.

4.3. Data collection, sampling frame and descriptive statistics

The United Nations Human Settlements Programme (UN-HABITAT), the agency for human settlements, has been assigned a mandated task, following the United Nations Millennium Declaration, of improving the lives of at least 100 million slum dwellers by the year 2020. Following this declaration, UN-HABITAT (2003) defines a slum household as a group of individuals living under the same roof, who are lacking any of five criteria, namely access to improved water, improved sanitation facilities, sufficient living area, a durable dwelling structure and a secured tenure. The choice of criteria, however, can be strengthened through an appropriate understanding of the type of adversities that slum inhabitants encounter. Therefore, this definition may be broadened in the context of a specific country (Bag and Seth, 2017).

In the Indian context, we first elaborate on slum typology and then discuss the sampling design based on the typology. Subsequently, we discuss the data that have been collected from two metro cities, namely Mumbai and Kolkata, followed by a description of the sample considered under this study. To measure the standard of living, we have constructed a multidimensional attainment index using ten different attainment indicators. We plot the distributions of the MIA score by the *eligible* households' caste certificate possession status to see whether there is any statistically significant difference between the two distributions. Finally, we present the descriptive statistics of the sample households.

4.3.1. Slum typology

In the Indian context, the term 'slum' loosely applies to two distinct settlement types, namely *tenement settlement* and *squatter settlement*.[60] *Tenement settlements* were mostly created during the colonial period by local landlords to provide shelters for migrant workers on the basis of a long-term lease agreement. Since the mid-ninetieth century in the colonial phase, both Mumbai and Kolkata observed a spurt of large-scale industrialization and urbanization sustained by a large number of migrant labourers (Bag and Seth, 2017). Landowners have either have rented out lands to these migrants to construct their own houses i.e., 'shanties' or have directly rented out quasi-permanent shanties on a long-term lease, usually with an upfront payment followed by a small rent. These lease agreements are known as *thika* in Kolkata and *pagri* in Mumbai.

Whereas, *Squatter settlements* have come into existence in the post-colonial period and are illegally occupied by clusters of quasi-permanent habitations along canals, railway tracks or roads or vacant degraded lands. From the legal viewpoint, under the Slum Areas Improvement and Clearance Act (1956) of India, squatter settlements are primarily classified into two categories: registered and unregistered. This typology is important as each has implications in terms of entitlements to basic services. Registered squatter settlements are declared as slums by the local authorities and thus their dwellers deserve basic shelter requirements with some form of tenure security and access to certain civic facilities. Unregistered squatter settlements are however considered illegal and their dwellers are bereft of any entitlement to basic civic services and are under constant threat of eviction.

In both types of slum-settlements, the possession of houses is classified into two main cate-

[60]The tenement housing settlement is referred to as *Basti* in Kolkata and *Chawal* in Mumbai.

gories: owned houses and rented tenancy. The rented tenancy is sub-categorised into *thika/pagri* tenancy, informal tenancy (oral and unspecified tenure) and other tenancies, such as a short-lease or a shared tenancy.

In the post-colonial period, various acts and bills were passed towards protecting the shelter rights of the *tenement settlements'* residents, which prevented their further proliferation.[61] *Tenement settlements* in Kolkata and Mumbai are integral part of the cities' legal housing stock. As the *tenement settlements* are prevented from proliferation, two distinct factors have caused a rapid increase in *squatter settlements*, i.e., (i) a deluge of migrant labourers following the contemporaneously growing industrial bases and (ii) spill over from the existing *tenement settlements* due to the natural growth of the population.

4.3.2. Sampling frame

For ensuring the representativeness of the population, the survey employs a two-stage stratified sampling procedure. For the design of the survey, various slum-level information is used that is either available in the public domain or acquired through different government agencies. For Kolkata, the slum-level information has been collected from Basti data compiled by the Kolkata Municipal Corporation (KMC) in March 2008. There are 1,236 slum clusters across 122 of 144 wards that have 360,000 households. For Mumbai, the ward-wise population distribution from the 2009 Mumbai Human Development Report (Municipal Corporation of Greater Mumbai, 2010) has been used.

In the first stage of the survey, in each city, the municipal corporation areas have been strat-

[61]The Slum Area Improvement and Clearance Act of India (a Union Act) has been created in 1956 (accessed in April 2017; website: http://lawmin.nic.in/ld/P-ACT/1956/A1956-96.pdf). In Kolkata, the first Calcutta Thika Tenancy Act was created in 1949, the Calcutta Slum Clearance Bill was proposed in 1957 offering subsidised flats to evictees, and the Calcutta Thika Tenancy (Acquisition and Regulation) Bill was brought in 1981 to enhance the protection status further by enabling provision of basic amenities to the inhabitants and are directly under the purview of the local municipal corporation. In Mumbai, the Maharashtra Slum Areas (Improvement, Clearance and Redevelopment) Act was passed in 1971, by which most tenement housing settlements constructed before 1956 were censused and declared as slums.

ified according to the largest possible administrative divisions, for example, at the borough level in Kolkata and at the ward level in Mumbai. In the second stage of the survey, a number of slums have been randomly selected from each stratum, then from each selected slum, a collection of households has been randomly selected to be interviewed. In Kolkata, 63 slums are randomly selected from 15 boroughs, out of which 808 households have been interviewed. In Mumbai, 77 slums are randomly selected from 23 wards, out of which 1086 households have been interviewed. The design of the survey questionnaire is based on the latest round of the National Sample Survey (NSS) household questionnaire. Further details regarding data collection is available in Bag and Seth (2017) and Bag et al. (2020).

4.3.3. Data collection

The survey has been conducted during 2013-14 in the slums of the municipal corporation areas of the three Indian metro cities, namely Kolkata, Mumbai and Delhi (the capital city of India).[62] This dataset is suitable for this particular study as compared to the publicly available nationally representative datasets, such as National Sample Surveys (NSS), National Family Health Surveys (NFHS) and Indian Human Development Surveys (IHDS), because existing Indian nationally representative household surveys are either not representative at the slum level (Ahluwalia, 2011; Carr-Hill, 2013) or have not collected any information on the possession of caste certificates.

The survey has collected information at both the individual level and at the household-level by primarily interviewing the household heads. In the absence of a household head, an available adult member has been interviewed. At the household level, the survey has collected information on religion, caste, possession of various public-benefit cards, type of housing, access to basic facilities, access to government schemes, possession of assets, land and house ownership details and related incomes, consumption and expenditure details on basic food items and fuel. At the individual level, it has collected information on age, gender, marital

[62] This survey is a part of "NOPOOR" project and is funded by the European Commission.

status, age at marriage, education, migration, employment (including information of earning and past occupations), savings and insurance and some health related information.

4.3.4. Sample

In this analysis, we restrict our sample to Kolkata and Mumbai and to non-Muslim and non-Christian households only, in order to preserve the strength of the causal inference. We exclude Delhi from our analysis because Delhi offers different prospects to *eligible* beneficiaries. The city of Delhi does not belong to any states of India: it is a union territory administered by the central government of India. Unlike in Mumbai and Kolkata, an *eligible* beneficiary in Delhi is entitled to avail of the reservation benefit offered by the central government without needing to re-register the caste certificate with the Delhi authority, provided the caste of the beneficiary is listed in the central government list of *eligible* beneficiaries.

We do not include Muslim and Christian households in our sample because the available provisions for religion-based minority benefits may contaminate the impact of the caste certificate. The sample under study therefore includes households belonging to the Hindu, Sikhs, Jains, Buddhists and other religions of Indian origin.

Our final sample comprises of 1,353 households belonging to General, SC/ST and OBC categories. Table 4.2 in Section 4.1 presents the distribution of our final sample across *eligible* and *non-eligible* households by the possession and non-possession of the caste certificate. Nearly half the households (i.e., 49%) in our sample do not belong to the disadvantaged groups and are not *eligible* for a caste certificate. The other half of the sample (i.e., 51%) belongs to the disadvantaged groups and are eligible for a caste certificate.

There are 687 *eligible* households within the sample (see Table 4.2). Among the *eligible* households 60% are SC/ST and 40% are OBC. Within SC/ST households 53% have caste certificate while it is 42% within OBC households.

4.3.5. Standard of living

There are broadly two approaches that can be used for measuring the standard of living: a monetary approach and a non-monetary approach. The generally used indicators for the monetary approach include per capita income or per capita consumption expenditure. Among these two widely used monetary indicators, consumption expenditure is the preferred indicator for measuring the standard of living in developing countries rather than the income measure, this is because the income measure often tends to be less reliable and fails to capture the long-run standard of living (Deaton, 1997; Meyer and Sullivan, 2003). In our context, however, consumption expenditure may not capture the variations in the standard of living across slum-households effectively. This is fairly reasonable for the following reasons: within our sample, 59% of the 1,353 households and 58% of the 687 *eligible* households avail of rationed commodities through public distribution systems at prices that are lower than market prices. These households may incur lower consumption expenditure and this may not necessarily translate to a lower standard of living in terms of food intake. There is also a supporting argument in the literature that monetary measures may not accurately capture the standard of living, especially among the poor (see, for example, Sen, 1999; Whelan et al., 2004; Drèze and Sen, 2011). In Table 4.3 we present the monthly per capita expenditure on food and the monthly per capita total consumption expenditure based on food and fuel for households belonging to disadvantaged groups using the caste certificate possession status. We do not observe any statistically significant differences in the monetary measures.[63]

Therefore, we pursue the direct approach to assess the standard of living using non-monetary indicators, i.e., multidimensional index of attainment. To construct the multi-dimensional index of attainment scores, we create a composite measure by combining each household's attainments in the different indicators applying a counting approach framework (Atkinson,

[63]The lack of statistical significance in the mean difference for the monetary measures could be due to a small sample. A large sample may be needed to examine the robustness of the estimates.

Table 4.3: Monetary versus non-monetary measure for the *eligible* households

Household characteristics	With CC mean	Without CC mean	Difference in mean	
Monthly per capita expend. on food (in INR)	1,167	1,195	-28	(0.575)
Monthly total consumption expend. (in INR)	2,076	1,997	79	(0.438)
Monthly per capita total earning (in INR)	3,955	3,583	372	(0.103)
Monthly per capita labour earning (in INR)	3,847	3,522	325	(0.151)
MIA Score (0-1)	0.58	0.51	0.07	(0.000)
Observations	334	353	687	

Notes: In the final column, p-values for the differences in means are reported in parentheses. Table presents the mean difference in monetary and non-monetary measures of the living standard for the *eligible* households by caste certificate possession status.
No statistically significant difference in earnings is observed for a sample size of 687 data points (with approximate 300 in each groups). A statistical power analysis reveals that a sample size of at least 2,612 (with 1,306 per group) is required to observe a statistically significant earnings difference of 325 rupees with the 5% critical value. In other word, our sample size does not have enough power to conclude a statistically significant mean difference of the observed magnitude (i.e., in income) across these two groups (i.e., with and without caste certificate).
Source: Estimates are based on authors' own computations using the survey data.

2003; Alkire and Foster, 2011).[64] We select a set of ten attainment indicators, adapting from Bag and Seth (2017). These include having access to (1) improved water facilities, (2) a personal toilet facility, (3) quality of a house, (4) a leak-proof house, (5) a room without over-crowding, (6) no exposure to health hazards, (7) not having a chronic disease or disability, (8) have access to a saving instrument (bank account), (9) have at least one of the essential assets (such as washing machine, refrigerator, air conditioning machine, computer, four-wheeler and additional rent generating property in city), (10) have at least a land-line phone for communication (refer to the summary in Table 4.4).

Note that an attainment condition for an indicator reflects a lack of deprivation in that indicator (i.e., *one* minus a deprivation condition). We define a deprivation (i.e., an attainment failing) condition for each indicator such that if a household cannot fulfil an attainment condition for an indicator, then the household is assigned a value of *one* for that indicator; otherwise, the household is assigned a value of *zero* for that indicator (refer to Table 4.4). Table 4.5

[64]For further details about the counting approach framework and its comparison with the social welfare approach, see Atkinson (2003). An axiomatisation of the approach to multidimensional poverty measurement has been presented by Alkire and Foster (2011). Also, refer to Alkire et al. (2015, Chapter 4) for various applications of the counting approach.

presents the descriptive statistics for each of the attainment indicators.

Table 4.4: MIA components

Components	**Deprivation/attainment failing condition(s) equal to *one* if:**
(1) Unimproved water facility	The water source is non-improved[a] (UN-MDG); or, the source is stand-piped but time to fetch from source is 30 min or more; or, the source is stand-piped but access duration is less than 2 hours per day.
(2) No personal toilet facility	There is no personal facility; or, the personal facility is shared with others.
(3) Unimproved house type	The wall or the roof or the floor of the house is built with unimproved materials[b].
(4) Leakage in house	Water enters in the house through roof or ground or both.
(5) Over-crowding	More than three persons live per bedroom (UN-HABITAT)
(6) Exposure to health hazard	Biomass fuel is used; or, cooking is done inside sleeping room with no smoke outlet.[c]
(7) Chronic disease/disability	Any member suffers from chronic disease or there is a disabled member of the household and no one in the household has any health insurance scheme.
(8) No bank access	No member in the household has any instrument for savings[d].
(9) No asset ownership	The household does not have any of the assets: washing machine, refrigerator, air conditioning machine, computer, four-wheeler and additional rent generating property in city.[e]
(10) No phone access	The household does not have a land-line phone and the number of mobile phones is less than the number of adults (aged 15 years or more).

Notes: [a]Unimproved sources include tanker truck, small cart, non-mineral bottled water, surface water (river/pond/lake) and other sources.
[b]Unimproved floor materials: mud, dung, sand, loose brick, stone slab, bamboo and raw wood planks. Unimproved wall materials: thatch, palm leaf, grass, wood, mud, bamboo, stone slab, rustic mat, tile, unburned brick, loosely packed stones and tin-shed. Unimproved roof materials: thatch, palm leaf, wood, mud, bamboo, stone slab, rustic mat, tile, unburned brick, cardboard and tin. Or, there is no house, people living under some kind of shed made of poor materials.
[c]Biomass fuel is used; or, cooking is done inside sleeping room with no smoke outlet.
[d]Savings instruments: savings account or recurring deposit in banks, savings account in post office, life insurance account, private provident fund account or contributory provident fund account.
[e]Assets include washing machine, refrigerator, air conditioning machine, computer, four-wheeler and additional rent generating property in city.
Source: The indicators and the attainment failing conditions are adopted from Bag and Seth (2017).

Table 4.5: Attainment indicators for the *eligible* households

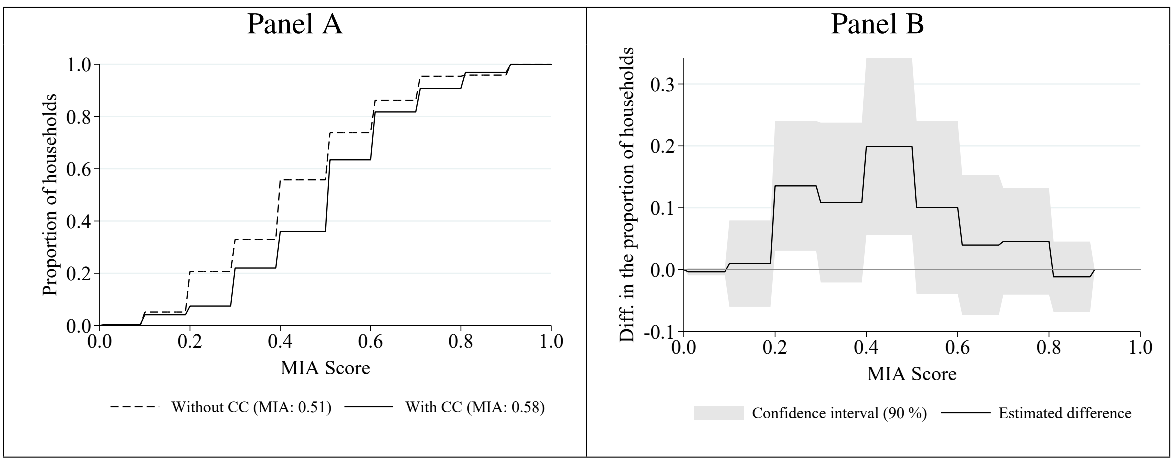
Household characteristics	SC/ST	OBC	All[4]	All With CC[5]	All Without CC[5]	Difference in Mean	
(1) Improved water	0.77	0.88	0.81	0.83	0.79	0.04	(0.160)
(2) Personal toilet	0.13	0.15	0.13	0.14	0.12	0.02	(0.465)
(3) Improved house-type[1]	0.32	0.45	0.37	0.39	0.35	0.04	(0.236)
(4) No house-leak	0.35	0.54	0.43	0.47	0.39	0.09	(0.020)
(5) No over-crowding	0.47	0.45	0.46	0.45	0.47	-0.02	(0.688)
(6) No exposure to health hazard[2]	0.78	0.80	0.79	0.84	0.73	0.11	(0.000)
(7) No chronic disease or disability	0.69	0.76	0.72	0.78	0.67	0.11	(0.001)
(8) Bank account	0.82	0.90	0.85	0.90	0.81	0.09	(0.000)
(9) Asset[3]	0.45	0.63	0.52	0.58	0.46	0.11	(0.003)
(10) Have phone access	0.26	0.43	0.33	0.37	0.29	0.09	(0.014)
Observations	412	275	687	334	353	687	

Notes: We present the proportion of attainments for each MIA indicator and a mean difference (in percentage points) for each indicator, differenced by the household's caste certificate possession status. In the final column, p-values for the mean differences are reported in parentheses.
[1]The wall or roof or floor of the house is built with unimproved materials. Unimproved floor materials include mud, dung, sand, loose brick, stone slab, bamboo and raw wood planks. Unimproved wall materials: thatch, palm leaf, grass, wood, mud, bamboo, stone slab, rustic mat, tile, unburned brick, loosely packed stones and tin-shed. Unimproved roof materials: thatch, palm leaf, wood, mud, bamboo, stone slab, rustic mat, tile, unburned brick, cardboard and tin. Or, there is no house, people living under some kind of shed made of poor materials. [2]Biomass fuel is used; or, cooking is done inside sleeping room with no smoke outlet. [3]Assets include washing machine, refrigerator, air conditioning machine, computer, four-wheeler and additional rent generating property in city. [5]All means SC, ST and OBC households.
[5]CC: abbreviation for caste certificate.
Source: Estimates are based authors' calculations using the survey data.

We obtain a multidimensional index of attainment (MIA) score for each household by simply counting the number of attainments in the ten different indicators and then dividing the attainment count by the maximum feasible number of the attainments (which is ten in this case). This implies that we use an equal weighting system for each indicator. By construction, the MIA-score for every household ranges between *zero* and *one*. Intuitively, an MIA-score of *zero* signifies that a household has been unsuccessful in meeting all the ten attainment conditions simultaneously, and therefore experiences the worst possible standard of living among the slum dwellers. On the other hand, an MIA-score of *one* implies that a household has successfully attained all the ten attainment conditions, and therefore experiences the highest possible standard of living among the slum dwellers. The average MIA score for the *eligible* households by the status of caste certificate holding is reported in Table 4.3. Clearly, the average MIA score for the *eligible* households with caste certificates is significantly higher than for the *eligible* households without caste certificates.

Figure 4.1, Panel A, plots the distributions of MIA scores for the *eligible* households by their caste certificate possession status. Figure 4.1, Panel B, plots the differences in these MIA scores by the household's caste certificate possession status within 90% confidence intervals to show whether these differences are statistically significant.

Figure 4.1: Distributions of the MIA-scores by the *eligible* households' caste certificate possession status



Notes: Panel A plots proportion of households with MIA score by households that possess caste certificate (solid line) and households that do not possess caste certificate (dashed line). The average MIA score for each group is reported within parentheses in the legend. The 'difference' in Panel B is *the proportion of households with caste certificates* minus *the proportion of households without caste certificates*. CC: Caste Certificate.
Source: Estimates are based on authors' calculations using the survey data.

The horizontal axes in both the diagrams present the MIA score. In Panel A, the vertical axis presents the proportion of households with at most a certain MIA score; whereas, in Panel B, the vertical axis presents the difference in two proportions (i.e., the proportion of households with caste certificates minus the proportion of households without caste certificates). We notice from Panel A that the MIA score distribution for households with caste certificates lies mostly to the right of the same for those without caste certificates. Equivalently, the difference curve in Panel B lies above *zero*, except for the extreme MIA scores. The difference between the two distributions is not statistically significant, which may be attributed to a small sample size. However, the average MIA score of the households with caste certificates is still 0.07 point higher (statistically significant at the 1% level) than the average MIA score of households without caste certificates (see Table 4.3). Table 4.6 presents the average MIA score for different sub-samples of the *eligible* households.

4.3.6. Descriptive statistics

The selected household characteristics that are considered in this analysis include average age and average education of all adult members of a household who are between the ages of 18–65, gender of the head of a household, size of a household, child dependency ratio (i.e., total number of dependent children below the age of 15 divided by total household size), adult dependency ratio (i.e., total number of adults aged 65 or above divided by total household size). Table 4.6 presents the descriptive statistics of the relevant variables and their mean differences by caste certificate possession status.

The majority of non-migrant (i.e., native people from a own state of origin) households are likely to possess caste certificates to avail the reservation benefit which is apparent from the data descriptive statistics. Table 4.6 shows that the proportion of non-migrant households with caste certificates is higher by 21 percentage points compared to the proportion of non-migrant households without caste certificates.

The average education of household heads is 1.82 years higher in households that have caste certificates compared to those that do not possess caste certificates. Similarly, the average education of all adult members in a household is 1.70 years higher in households with caste certificate compared to those that do not have caste certificates.

A government job is one of the primary variables in this study. In this sample, government occupations include accountant, airport or railway worker, Angarwadi worker (i.e., one who works in rural child-care and health-care centres in India), artist, musician, assistant, bank employee, employees in the telecommunication industry, business construction, business shop owner, cleaning staff, clerk, peon (who provides menial service in an office), office boy (who provides menial service), commission agent/broker, computer or data entry operator, cook/catering chef, delivery/courier service, domestic helper, auto-driver, taxi drivers, casual labourer, midwife, nurse, hospital staff, pharmacist, Ministry, carpenter, Ministry electrician/welder/plumber, security guard, sweeper, teacher, gardener, etc.[65]

For analytical purposes, we define a government job being held by a household as a binary variable, such that we assign a value of *one* if at least one member in a household (between the ages of 18-65) is working in a government sector occupation; otherwise it is assigned as value of *zero*. In the full sample, 14% of households have at least one member working in a government sector occupation. The proportion of government job being held by at least one member of the household is higher by 7 percentage points for *eligible* households that possess caste certificates compared to households that do not have caste certificates (refer to Table 4.6 below).

[65] Our dataset does not have information on whether the government jobs are offered by a state government or by the central government. We assume that these jobs are potentially related to state governments because the central government jobs are likely to demand high educational qualifications.

Table 4.6: *Eligible* household characteristics

Household characteristics	All	SC/ST	OBC	All with CC	All without CC	Difference in mean	
Outcome Variables:							
MIA Score	0.54	0.50	0.60	0.58	0.51	0.07	(0.000)
Mediator variable							
At least one member has govt. job[1]	0.14	0.15	0.12	0.17	0.10	0.07	(0.007)
Explanatory variable:							
Caste certificate	0.49	0.53	0.42	-	-	-	
Non-migrants (instrument)	0.52	0.54	0.49	0.63	0.42	0.21	(0.000)
Head education	6.22	5.54	7.24	7.15	5.33	1.82	(0.000)
Average adult education[2]	7.61	6.98	8.55	8.48	6.78	1.70	(0.000)
Average age of adult[2]	36.61	36.53	36.74	36.19	37.01	-0.82	(0.104)
Head's age	48.70	48.45	49.09	48.79	48.62	0.17	(0.851)
Head is female	0.20	0.21	0.18	0.19	0.21	-0.02	(0.430)
Household size	4.85	4.80	4.93	4.96	4.75	0.21	(0.191)
Child dependency ratio[3]	0.19	0.20	0.19	0.19	0.19	-0.00	(0.972)
Adult dependency ratio[4]	0.04	0.04	0.05	0.04	0.04	-0.00	(0.718)
Observations	687	412	275	334	353	687	

Notes: In the final column, p-values for the differences in means are reported in parentheses.
All means SC, ST and OBC households together. [1]Household members having a government job are aged between 18-65 years. The government occupations primarily include accountant, airport or railway worker, Angarwadi worker, artist, musician, assistant, bank employee, business process outsourcing (BPO) employees or telecommunication industry, business construction, business shop owner, cleaning staff, clerk, peon, office boy (provides menial service), commission agent/broker, computer or data entry operator, cook/catering chef, delivery/courier service, domestic help, auto-driver, taxi drivers, casual labourer, midwife, nurse, hospital staff, pharmacist, Ministry, carpenter, Ministry electrician/welder/plumber, security guard, sweeper, teacher, gardener, etc.
[2]All adult members are between the ages 18–65.
[3]Child dependency ratio (i.e., total number of dependent children below the age of 15 divided by total household size).
[4]Adult dependency ratio (i.e., total number of adults aged 65 or above divided by total household size).
Source: Estimates are based on authors' calculations using the survey data.

4.4. Empirical strategy and identification

We start with an OLS estimation procedure to examine the correlation between the possession of a caste certificate and the standard of living of an *eligible* household using the following equation:

$$MIA_i = \alpha_0 + \beta_0 CC_i + \mathbf{\Theta}_0 \mathbf{X}_i' + \delta_0 C_i + \varepsilon_{0i}, \tag{4.1}$$

where MIA_i denotes MIA score for the i^{th} household; CC_i is a binary variable, such that a value of *one* is assigned whenever the i^{th} household possesses a caste certificate and a value of *zero* is assigned otherwise; vector $\mathbf{X}_i$ comprises of various household-level characteristics and vector $\mathbf{\Theta}_0$ is the set of coefficients corresponding to the covariates in $\mathbf{X}_i$; C_i is a city-level binary variable, such that a value of *one* is assigned whenever the i^{th} household belongs to the city of Kolkata and a value of *zero* is assigned whenever the household belongs to the city of Mumbai; ε_{0i} is the error term. We are primarily interested in testing the proposition that the possession of a caste certificate is associated with a higher standard of living for an *eligible* household. This means, we test whether $\beta_0 = 0$ against $\beta_0 > 0$.

The OLS estimate may suffer from either a downward or an upward bias in the β_0 estimate in Equation 4.1. This is because, whether to register for a caste certificate cannot be predetermined by birth although, caste is determined by birth. Therefore, registering for a caste certificate involves an individual choice which is often unknown. Such an unobserved factor may be individual stigma which may play a significant role in not choosing to applying one (Gille, 2013). Thus, stigma may reduce the chance of holding a valid caste certificate. However, stigma may have either a positive or a negative impact on the selected outcome variable (i.e., standard of living). This is because some *eligible* households may achieve a higher standard of living without considering the reservation benefits, while others may achieve a lower standard of living for not considering the reservation benefits; this is due to stigma attached to using a caste certificate. In this case, the direction of bias is ambiguous. Similarly, another unobserved factor, such as an awareness regarding the benefits of a caste certificate can increase the chance of holding a valid caste certificate; Awareness also increases the chance attaining higher standard of living. Therefore, the estimate of β_0 is likely to have an upward bias.

To control for this endogeneity in the possession of a caste certificate, we use an instrumental variable approach. We use the information on whether an *eligible* household is residing in a city within its *state of origin* (i.e., a non-migrant household) to instrument whether an *eligible* household possesses a caste certificate. We use the terms 'non-migrant' and 'native' interchangeably.

We now proceed to elaborate on the validity of the instrumental variable. We define a *non-migrant* household as one that is relocated to a new city for a job or for other reasons but residing in the same *state of origin*. If a household remains in the same *state of origin* and it possesses a caste certificate then that household has a valid caste certificate. Therefore, residing in the *state of origin* increases the chance of the possession of a valid caste certificate.

However, the instrument may not be free of caveats. Being a native to a state may have its own positive impact on SOL. We therefore, undertake an empirical test to examine whether the instrument, conditional on a set of control variables $\mathbf{X}$, has any direct impact on the outcomes of interest (i.e., MIA score and government job holding). In Appendix Table A4.4, we present the results of this test. The null effects of the instrument of the outcomes of interest guarantee that the instrument is a fairly reliable fit for the purpose of our study. We have also tested the impact of the instrument on each individual component of MIA measure. The results are presented in Appendix Table A4.5. Given that the instrument has direct positive impact on two out of the ten indicators of MIA measure, namely 'No chronic disease or disability' and 'Number of asset ownership', we have dropped those two components from the regression analysis.

We denote our instrument by S, such that $S_i = 1$ for the i^{th} household whenever the household has relocated within its *state of origin* and $S_i = 0$ otherwise. We use a 2SLS procedure to estimate the impact of the possession of a caste certificate on an eligible household's standard of living (i.e., MIA scores).

The first stage equation for a 2SLS procedure is given by:

$$CC_i = \alpha_1 + \gamma_1 S_i + \mathbf{\Theta}_1 \mathbf{X}_i' + \delta_1 C_i + \varepsilon_{1i}. \tag{4.2}$$

We predict $\widehat{CC}$ from Equation 4.2. The second stage equation can be written as:

$$MIA_i = \alpha_2 + \beta_2 \widehat{CC}_i + \mathbf{\Theta}_2 \mathbf{X}'_i + \delta_2 C_i + \varepsilon_{2i}. \tag{4.3}$$

The key coefficient of interest is β_2. We are interested in testing the proposition whether the possession of a caste certificate improves an *eligible* household's standard of living. We, therefore, examine whether $\beta_2 = 0$ against $\beta_2 > 0$.

The government policies provide representation to all *eligible* groups through reservation in government jobs. The procurement of government jobs under reservation has a direct impact on earnings and on overall well-being of the disadvantaged groups (Bertrand et al., 2010; Thorat et al., 2016; Kumar et al., 2019; Deshpande and Ramachandran, 2019). In addition, Government jobs are highly sought after in India. It is not just income but a sense of job security achieved through having a government job, which enables households to invest more on house maintenance and repair activities to improve their standard of living given the multi-dimensional welfare metric used in this study. Thus, having a government job increases the certainty and predictability of income streams and thus reducing risk and uncertainty when making decisions about improving household residence. We therefore, consider the procurement of a government job by at least one household member as one of the possible channels for the relevant impact of the possession of a caste certificate on a household's standard of living.

While there are several studies in the literature that have used causal mediation analysis, such as Conti et al. (2016), Moya and Carter (2018) and Hörner et al. (2019), we follow Hörner et al. (2019).

We define a binary variable G, such that $G_i = 1$ whenever the i^{th} household has at least one member between the age of 18–65 with a government job, and $G_i = 0$ otherwise. We use a 2SLS procedure for a mediation analysis. In the first step, we evaluate a causal impact of the possession of a caste certificate on the probability of government job holding by at least a member of a household using the following equation,

$$G_i = \alpha_3 + \beta_3 \widehat{CC}_i + \mathbf{\Theta}_3 \mathbf{X}'_i + \delta_3 C_i + \varepsilon_{3i}, \tag{4.4}$$

where $\widehat{CC}$ is estimated using Equation 4.2. In this case, we examine whether $\beta_3 = 0$ against $\beta_3 > 0$. We estimate the predicted values of $\hat{G}$ from Equation 4.4 and evaluate the mediation impact on the standard of living using the following equation:

$$MIA_i = \alpha_4 + \eta_1 \hat{G}_i + \mathbf{\Theta}_4 \mathbf{X}'_i + \delta_4 C_i + \varepsilon_{4i}. \tag{4.5}$$

The predicted value of G (i.e., a mediating variable) is assumed to be independent of the error term ε_{4i}. This implies that no unobserved factors exist that may affect the outcome (MIA_i) and the mediator (G). Hence, the correlation between ε_{3i} and ε_{4i} is *zero*. In Equation 4.5, the estimated value of η_1 captures the impact of the mediator G on an *eligible* household's standard of living. In this case, we examine whether $\eta_1 = 0$ against $\eta_1 > 0$. We use the bootstrap method with 1,000 replications to obtain precise standard errors of the estimate of η_1.

4.5. Results

We first descriptively examine whether there are any differences in the two outcomes of interest, namely standard of living and in the rates of securing government jobs between the slum-households belonging to different caste groups. The pairwise comparison is made between all the *eligible* and the General households; between the *eligible* households that do not possess a caste certificate and the General households; between the *eligible* households that possess a caste certificate and the General households; and within the *eligible* households—between those that possess and those that do not possess a caste certificate. In these pairwise comparisons, we find that the *eligible* slum-households that have caste certificates experience a higher standard of living (marginally significant at the 10% level) and a higher rate of securing government jobs. For a causal analysis, we consider the sample of *eligible* (i.e., SC/ST, OBC) households only.

4.5.1. Descriptive regression analysis

In Table 4.7, we pairwise compare the households by their caste categories to examine whether there exist any differences in the two outcomes. We construct four binary variables for each of the four categories defined above to facilitate the pairwise comparison. The regression results for each pairwise comparison is presented in the four adjacent rows of Table 4.7. The second and third columns of the table stand for the two outcome variables of interest: MIA score and government job.

In the first column of the table, we do not observe any statistically significant difference in the average MIA scores between the *eligible* and the General category households. However, the difference becomes conspicuous when we compare within the *eligible* households, between those that possess caste certificates and those that do not possess caste certificates (see the first column and the last row of Table 4.7). The result shows that the *eligible* households that possess caste certificates have a higher MIA score of 0.022, on average, than the households that do not possess caste certificates (marginally significant at the 10% level). Similarly, the third row and the second column of the table reveal that the possession of caste certificates by the *eligible* households increases the rate of procurement of government jobs by at least one member per household by 5.5 percentage points compared to the General category slum-household. In the last column and the last row of the table, the result further reveals, within the *eligible* households, the possession of caste certificates increases the rate of procurement of government jobs by at least one member per household by 5.8 percentage points. These results are statistically significant at the 5% level. Therefore, these findings descriptively reveal that the *eligible* households with caste certificates experience a higher standard of living and a higher chance of securing government jobs.

Table 4.7: Pairwise comparison of the households: Difference in the selected outcomes

Household types	Difference in Average MIA Scores (OLS)	Difference in Probability of Government Job (OLS)
Eligible VS. General	-0.001	0.028
	(0.942)	(0.125)
	[0.293]	[0.042]
	⟨1,353⟩	⟨1,353⟩
Eligible No Caste Cert. VS. General	-0.014	0.001
	(0.235)	(0.953)
	[0.291]	[0.042]
	⟨1,019⟩	⟨1,019⟩
Eligible with Caste Cert. VS. General	0.015	0.055^{**}
	(0.184)	(0.021)
	[0.298]	[0.065]
	⟨1,000⟩	⟨1,000⟩
Eligible with Caste Cert. VS. *Eligible* without Caste Cert.	0.022	0.058^{**}
	(**0.101**)	(0.025)
	[0.299]	[0.032]
	⟨687⟩	⟨687⟩

Notes: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$. Two-sided p-values are reported in parentheses.
R2 are reported in square brackets. Observations are reported in angular brackets.
Eligible category includes SC/ST and OBC households. This table descriptively shows whether possession or non-possession of a caste certificate makes any difference in MIA scores and in the procurement of government jobs within the pairwise groups. The household level characteristics include average education of all working aged members of the household (i.e., who are between the ages of 18–65 years) and its square, average age of all working aged members of a household and its square, gender of household head, household size, adult dependency ratio, child dependency ratio, city dummy variable for Kolkata (considering Mumbai as a base dummy).
Source: Estimates are based on authors' calculations using the survey data.

4.5.2. Impact of caste certificate on standard of living of *eligible* households

OLS results in Table 4.8 reveal that the possession of caste certificates, on average, increases the MIA score by 0.028 of a unit (i.e., from the mean of 0.54 unit to 0.568 unit) for all *eligible* households and by 0.043 of a unit (i.e., from the mean of 0.60 unit to 0.643 unit) for OBC households (both the results are statistically significant at the 5% level).

If we look at the individual components of the attainment index, we find that the possession of caste certificates, on average, increases the rate of access to a bank (i.e., saving) facility by 6.5 percentage points for all *eligible* households (average is 85%, see Table 4.5), by 7.7 percentage points for SC households (average is 82%) and by 4.5 percentage points for OBC households (average is 90%). While the rate of house-leak for OBC households reduces by 8.6 percentage points (average is 54%), the rate of exposure to health hazard reduces by 11.5 percentage points for OBC households (average is 80%), and it reduces by 7.1 percentage points for all *eligible* households (average is 79%).

Before proceeding with a causal analysis, we first examine the validity of the instrument for the possession of a caste certificate. The first row in Appendix Table A4.3 shows that being a non-migrant increases the probability of the possession of caste certificates by 16.5 percentage points for SC households, by 20.1 percentage points for OBC households and by 17.4 percentage points for all *eligible* households. The third row of Appendix Table A4.3 shows that the Kleibergen-Paap Wald F-statistics for SC/ST, OBC and all *eligible* households are 12, 11 and 22 respectively. It is noteworthy that the dependent variable in the first stage regression equation is a binary variable (i.e., whether or not a household has a caste certificate). Therefore, the Kleibergen-Paap Wald F-statistics should be interpreted with some caution here.

The use of the 'ivreg' command reports Stock and Yogo (2005) weak instrument critical values. The F-test values (see Appendix Table A4.3) suggest that the relative finite sample bias for the sample of SC/ST households is roughly 8% (i.e., $1/12$, which is below 20% maximal IV relative bias but above 10% bias). However, for OBC households, the relative finite sample bias is roughly 9% (i.e., $1/11$, which is slightly less than 10% maximal IV relative bias but above 5% bias). However, for the whole sample of *eligible* households, the Kleibergen-Paap Wald F-statistics is 22; this means that the relative finite sample bias is roughly 4.5% (i.e., $1/22$, which is less than the maximal IV relative bias of 5%). Therefore, the instrument can still be reliable for the samples of all *eligible* and OBC households.

In order to shed light on the orthogonality of the instrument, we consider the fact that residing in a *state of origin* (i.e., an ancestral state) is unlikely to be influenced by any unobserved decisions consciously made by a household, especially when people are living in their ancestral states for generations. In addition, an instrument should influence the outcome variables through the problematic endogenous regressor (i.e., possession of a caste certificate) but should not directly influence the outcome variables of interest (such as the MIA score and the components of the attainment index). The empirical results reveal there are no statistically significant impacts of the instrument on the outcome variables of interest (refer to Appendix Tables A4.4 and A4.5). The third column of Appendix Table A4.4 shows that the instrument does not have any direct impact on the MIA score (which is based on all 10 indicators discussed in Section 4.3.5). We further test the direct impact of the instrument on each of the 10 attainments (refer to Appendix Table A4.5). We find the instrument does not have a statistically significant impact on eight out of the ten indicators, while it has a statistically significant positive impact on two of these indicators, namely not having chronic disease or disability and asset ownership. Therefore, we drop these two attainment components from the regression analyses that are based on the individual attainment components (see Table 4.8).

The causal findings in Table 4.8 show that, on average, a one percentage point increase in the rate of caste certificate possession increases the MIA score by 0.0017 of a unit for OBC households. The result is statistically significant at the 10% level. The average MIA score for OBC households is 0.60 (see Table 4.6).

Among the eight components of the attainment index, we find that, on average, a one percentage point increase in the possession of the caste certificate rate reduces the rate of house-leak by 0.38 of a percentage point for all *eligible* households (statistically significant at the 5%

level). The average rate of no house-leak for all *eligible* households is 43% (see Table 4.5).

Similarly, on average, a one percentage point increase in the rate of caste certificate possession reduces the rate of house-leak by 0.43 of a percentage point for OBC households (statistically significant at the 10% level). The average rate of no house-leak for OBC households is 54% (see Table 4.5).

Table 4.8 further reveals that, on average, a one percentage point increase in the rate of caste certificate possession increases the rate of non-exposure to a health hazard by 0.35 of a percentage point for OBC households (marginally significant at the 10% level). The average rate of non-exposure to a health hazard for OBC households is 80% (see Table 4.5).

These findings suggest that the impacts of a caste certificate on MIA score and on the attainment indicators are predominantly relevant to OBC slum-households.

Table 4.8: Effect of caste certificate on the MIA scores and the attainment components

	OLS			2SLS		
	SC/ST	OBC	SC/ST & OBC	SC/ST	OBC	SC/ST & OBC
MIA score	0.017	0.043**	0.028**	0.016	0.172*	0.081
One-tail p-value	(0.171)	(**0.024**)	(**0.020**)	(0.435)	(**0.071**)	(0.148)
R^2	0.285	0.254	0.304	0.285	0.155	0.288
Attainment indicators:	LPM			2SLS		
Improved water facility	0.013	-0.005	0.009	-0.001	-0.132	-0.016
One-tail p-value	(0.379)	(0.551)	(0.387)	(0.502)	(0.739)	(0.536)
R^2	0.076	0.073	0.075	0.076	0.040	0.074
Personal Toilet	0.001	-0.010	-0.002	0.092	-0.156	-0.017
One-tail p-value	(0.487)	(0.583)	(0.535)	(0.329)	(0.744)	(0.545)
R^2	0.048	0.038	0.036	0.031	-0.001	0.036
Bank	0.077**	0.045	0.065***	-0.158	-0.133	-0.150
One-tail p-value	(**0.027**)	(**0.101**)	(**0.009**)	(0.750)	(0.732)	(0.818)
R^2	0.095	0.066	0.086	0.013	-0.011	0.005
Improved house-type	-0.048	0.016	-0.021	-0.099	0.065	-0.028
One-tail p-value	(0.851)	(0.399)	(0.709)	(0.649)	(0.419)	(0.554)
R^2	0.169	0.028	0.114	0.167	0.026	0.114
No House Leak	0.025	0.086*	0.047	0.321	0.428*	0.380**
	(0.310)	(**0.086**)	(0.113)	(0.133)	(**0.097**)	(**0.045**)
R^2	0.097	0.060	0.096	0.014	-0.045	-0.004
No Over Crowding	0.020	-0.052	-0.008	-0.075	-0.036	-0.109
One-tail p-value	(0.336)	(0.821)	(0.586)	(0.610)	(0.552)	(0.709)
R^2	0.247	0.283	0.250	0.239	0.283	0.241
No health hazard	0.040	0.115***	0.071***	-0.336	0.346*	-0.093
One-tail p-value	(0.167)	(**0.006**)	(**0.012**)	(0.894)	(**0.095**)	(0.693)
R^2	0.046	0.081	0.047	-0.134	0.007	0.012
At least a land-line	-0.024	0.121**	0.037	-0.349	0.032	-0.176
One-tail p-value	(0.705)	(**0.023**)	(0.147)	(0.906)	(0.456)	(0.814)
R^2	0.184	0.204	0.204	0.066	0.197	0.158
Observations	412	275	687	412	275	687
F-Statistic				12	11	22

Notes: One sided p-values are reported in parentheses.
Controls for household level analysis include average education of all working aged household members (i.e., who are between the ages of 18–65 years) and its square, average age of all working aged members of household (18-65 years) and its square, gender of household head, household size, adult dependency ratio, child dependency ratio, city dummy variable for Kolkata (considering Mumbai as a base dummy).
First stage regression results are presented in Appendix Table A4.3.
Source: Estimates are based on authors' calculations using the survey data.

4.5.3. Mediation analysis

For a mediation analysis, we empirically examine a causal impact of the possession of a caste certificate on the probability of government job procurement. The results presented in Panel I of Table 4.9 show that, on average, a one percentage point increase in the caste certificate possession rate for all *eligible* households increases the rate of procurement of government jobs by at least one member per household by 0.24 of a percentage point (statistically significant at the 5% level). The average rate of government job holding for all *eligible* households is 14% (see Table 4.6).

Table 4.9: Impact of caste certificate mediated through a government job

Panel I. Dep. variable:	Govt. Job: 2SLS		
	SC/ST & OBC	OBC	SC/ST
Caste Certificate ($\widehat{CC}$)	0.238*	0.395**	0.086
	(**0.062**)	(**0.044**)	(0.341)
Panel II. Dep. variable:	Mediation Analysis: MIA Score		
Govt. Job (Mediator $\widehat{G}$)	0.121**	0.113**	0.193
	(**0.019**)	(**0.019**)	(0.175)
Observations	687	275	412

Notes: One sided p-values are reported in parentheses.
Panel I presents regression of caste certificate on government job holding by at least a member in an *eligible* household and a set of control variables. The predicted value of government job is obtained from the regression equations for SC/ST, OBC and combined groups.
Panel II presents regression results for having a government job on MIA components. The predicted value of government job obtained in Panel I is used in Panel II regressions. The estimates are computed using a bootstrap method with 1,000 replications.
Controls for household level analysis include average education of all working aged household members (i.e., who are between the ages of 18–65 years) and its square, average age of all working aged household members and its square, gender of household head, household size, adult dependency ratio, child dependency ratio, city dummy variable for Kolkata (considering Mumbai as a base dummy) and a caste dummy for the overall (SC and OBC) group. First stage regression results are presented in Appendix Table A4.3.
Mediation analysis for all other components of MIA are reported in Appendix Table A4.6.
Source: Estimates are based on authors' calculations using the survey data.

Similarly, on average, a one percentage point increase in the caste certificate possession rate for OBC households increases the rate of procurement of government jobs by at least one member per household by 0.40 of a percentage point (statistically significant at the 10% level). The average rate of government job holding for OBC households is 12% (see Table 4.6).

These results reveal that the possession of caste certificates indeed increases the rate of government job holdings for the sample of all *eligible* households and for the sample of OBC households.

In Panel II of Table 4.9, we empirically test whether government jobs act as a mediator for the observed positive impact of the possession of caste certificates on the living standard of the *eligible* households, as seen in Table 4.8. Our findings in Table 4.9 show that, on average, a one percentage point increase in the government job rate increases the MIA score for all *eligible* households by 0.12 of a unit (statistically significant at the 5% level). The average MIA score for all *eligible* households is 0.54 of a unit (see Table 4.6). Similarly, on average, a one percentage point increase in the government job rate increases the MIA score for OBC households by 0.11 of a unit (statistically significant at the 5% level). The average MIA score for OBC households is 0.60 unit (see Table 4.6).

These findings suggest that the impact of caste certificate on the standard of living of slum-households mediated through government job positions is predominantly relevant for the sample of OBC households.

The reason for considering government jobs as a mediation channel is that the government jobs are highly sought-after jobs in India. It is not just the income but also the sense of job security and prestige achieved through having a government job. Thus, having a government job increases the certainty and predictability of earnings streams and thus the reducing risk and uncertainty when making decisions about improving household residence. In addition, if one has a government job, it is necessary to open a bank account. Thus, having a government job (than not having one) increases the chance of a household's access to a bank account (see the row numbered as (3) in Table A4.6). By holding a bank account, one can expect a positive impact on SoL. For instance, a bank account may enable an individual to secure bank loans for investment purposes. According to Nandhi (2012), there are several new schemes launched in 2009 to improve access to finance for the economically weaker sections of the community, such as migrant workers, slum dwellers, street hawkers, daily wage labourers, vegetable/fruit sellers, petty traders, housewives and students. These new schemes include the SBI Mini Saving Bank account (i.e., mobile banking in partnership with the State Bank of India (SBI)), the Apna Savings Account scheme in partnership with the ICICI Bank and Tatkal (a remittance facility) introduced by the SBI in the 2010s. These mobile banking facilities have many benefits, such as they provide easy access of credit to economically poor people, have very low transaction cost and provide secured banking services with a 3.5% interest rate per annum. Banerjee and Duflo (2011) also explain how brick-by-brick savings in bank account helps economically poor people to meet unforeseen emergencies, such as buying medicines and in finishing the construction of at least one entire room with a roof in one go. In addition, commercial (state-owned) banks provide micro-credit to economically weaker sections of people in India through Self-Help Groups since the launching of Bank Self-help Group Linkage programme in the early 1990s.[66] This programme established link between commercial banks, NGOs and self-help groups (see Basu and Srivastava (2005)). These bank-credits are provided for activities, such as income generation, housing, education, marriage etc.[67] Banerjee and Duflo (2011) explain that the SHG and Saving clubs that give loans to their members (who belong to economically weaker sections, out of the accumulated saving of the group) are very popular in India.

[66] SHG is a financial intermediary committee usually composed of 10 to 20 local women or men between 18 to 40 years.

[67] Government of India has also been using the SHGs for Credit Linked Subsidy Scheme (CLSS) for the poor. CLSS is a benefit under the Pradhan Mantri Awas Yojana which focuses on helping the middle-income groups, economically weaker sections and lower income groups in India by bringing down their housing loan by offering an interest subsidy. (this information is available in the website: https://www.indianeconomy.net/splclassroom/what-is-self-help-group-shg-bank-linkage-programme/

4.6. Discussion and conclusions

In India, social discrimination exists in the form of differences across castes (or jatis) and religions. Since independence, the Constitution of Indian has aimed to completely restructure Indian society in pursuit of the complete abolition of the ancient hierarchy. Although such abolition has never been feasible, it has been able to extend the reservation benefits beyond those that existed in the constitutional text. The disadvantaged groups often trail behind in various socio-economic outcomes, namely consumption, education, health and employment. In order to improve the standard of living of the *eligible* groups and to bring them to a level playing field with the rest of the population, the Indian government has undertaken various protective discrimination policies, such as reservation of places in higher education, in central and state government jobs and in the legislature.

Many recent studies have looked at the effect of these protective discrimination policies on the attainment of higher levels of education, securing government employment, earnings and political representations of disadvantaged groups. While all these studies have been conducted either at the national level or at a state level, none of them has focused on the poorest sections of Indian society, such as those disadvantaged groups that are residing in the city-slums. To fill some of the gaps in the existing literature, we have examined whether the benefits of reservation policies are percolating down to the poorest corners of society. We have examined the policy effect through caste certificate possession information, which is available from the unique slum-level dataset that has been collected during 2013-14. We have especially focused on the *eligible* non-Muslim and non-Christian households that reside in the urban slums of two Indian metro cities, namely Kolkata and Mumbai, to purge the possible effects of religion-based benefits from contaminating our results.

We have used a composite measure, namely the multidimensional index of attainment (MIA); this has been constructed using ten attainment indicators to capture the standard of living of the slum-dwelling households. Given that the possession of a caste certificate may be endogenously determined by unobserved factors (such as willingness to access the reservation benefits by registering for one or not registering for one due to to social stigma attached with the use of a caste certificate), we have used an instrumental variable approach to instrument whether a household has a caste certificate by *whether the household is residing in its state of origin*.

Our primary findings have revealed that a one percentage point increase in the caste certificate rate increases the MIA score for OBC households by 0.0017 of a unit on average. We have further found that the benefits of caste certificates are mediated through government job procurements by at least one member of slum-dwelling households. The results show that a one percentage point increase in the caste certificate rate increases the government job holding rate by 0.24 of a percentage point for all *eligible* households and 0.39 of a percentage point for OBC households. Consequently, on average, a one percentage point increase in the government job rate increases the MIA score for all *eligible* households by 0.12 of a unit and for OBC households by 0.11 of a unit.

The findings reveal that the benefits of a caste certificate are predominantly relevant to the sample of OBC households but not for the sample of SC/ST households. This implies that the possession of a caste certificate is primarily improving the access to government jobs for OBC households. This may widen the inter-caste disparity. While we find such possibility of inter-caste disparity at the slum-level, Deshpande and Ramachandran (2019) find a similar possibility at the national level.

In addition, a household's inter-state migration could potentially be motivated by its aspiration to improve its standard of living through finding secured jobs for its members. Therefore, if the rigidity in the state policy (i.e., a caste certificate issued by a given state cannot be used in another state) is not relaxed, then improvement of the living standard for the disadvantaged slum-dwelling, and especially for SC/ST households, will be even more challenging.[68]

[68] SC/ST households are lagging behind OBC households within the disadvantaged groups in many aspects of welfare. See Table 4.1.

Therefore, liberalisation of such rigidity may be considered as an important agenda for future policies, which may widen the access to the relevant government benefits for the disadvantaged groups. However, such a reformation may be prone to debate.

The primary limitation of this study is that we do not know whether or not a household member's government job holding is secured through a reservation channel or an open channel. In addition, in the instrumental variable analysis, some caution is required given that the F-test values from first stage regressions are not very high. Therefore, further research on relevant instruments may be essential.

In this paper, we have explored only one mediation channel, i.e., the procurement of government jobs through which caste certificate works effectively in improving the standard of living within slums. As a future research agenda, it would also be interesting to explore an alternative mediation channel, such as attainment of higher education through reservation within slums.

Chapter 5. Conclusions

This thesis investigates three socio-economic challenges experienced by the Indian households over the past decades: first, whether a large family size affects education and health outcomes of the children; second, whether fertility affects female labour market outcomes (such as the market participation and hours of labour supply in the market); and third, whether the possession of a caste certificate improves the standard of living of disadvantaged households (namely Scheduled Caste (SC), Scheduled Tribes (ST) and Other Backward Class (OBC)) that are residing in the urban slums. Here, I summarise the contributions of my thesis to the literature, the key findings of each research question and suggest potential avenues for future research.

Chapter 2 investigates the possibility of a trade-off between child-quantity and child-quality in the Indian context and contributes to the literature by considering multiple measures for child-quality that includes both the schooling and health outcomes for all age groups of children: 1–4 (young) and 5–18 (school-aged). Child-quantity is measured by the number of children born to a family. The schooling outcomes include five indicators, namely completed years of schooling, school attendance, delay in years of schooling, ratio of actual years of schooling to expected years of schooling (ERT), age-standardised schooling index. I also use the test scores in reading, writing and arithmetic that are available for 8–11 year old children. The health outcomes include indicators, namely weight-for-age z-score, height-for-age z-score and BMI-for-age z-score. This study also examines the heterogeneity across different family sizes (i.e., how the difference in the number of children per family affects the outcomes), gender of children, types of settlement (urban versus rural) and types of family setting (extended versus nuclear).[69] The nationally representative household level dataset,

[69] In the earlier studies, child-quality has not been consistently studied using both education and health indicators. For examples, Kumar and Kugler (2017) have used schooling indicators for school-aged children. Sarin (2004), in his unpublished dissertation, uses quality indicators, such as height-for-age z-score, height-to-weight ratio and immunization (i.e., chance of receiving Measles vaccine) for below five year old children, born during the 1990s. He has not studied health outcomes for school-aged children. Azam and Saing (2018)

of the 2011 India Human Development Survey (IHDS-II) allows for such a comprehensive analysis. To strengthen the causal analysis, three alternative instruments are used for child-quantity such as *twin-births*, n^{th} *delivery of twins* and *same gender composition of the first two children*. The empirical findings reveal there are negative sibling impacts on children's schooling and health outcomes. The negative impacts of an additional child on average years of schooling completion and ERT are relevant to the urban settlement and in the nuclear family setting, whereas the impacts on health outcomes of children are relevant to the rural settlement and to both the extended and the nuclear family settings. The regression models based on different family sizes reveal that these negative impacts of child-quantity on the schooling outcomes of children primarily emerge from the families having at least five children. These findings are robust to birth order of children. *Twin-birth* and *same-gender composition*, as instruments, have picked up slightly different magnitudes of trade-off; this is potentially because of the local average treatment effect that may vary by the choice of an instrument. This study tries to address the birth spacing concern related to *twin-births* by controlling for age gap between the first and last child born to a woman.[70] A limitation of this study is that this study could not empirically investigate the resource reallocation possibilities by parents towards non-twin children. This will require a suitable dataset and is beyond the scope of the current investigation. As a future research agenda, it would be interesting to study how parents reallocate their resources among children after twin births by the types of parents (i.e., urban parents, who might be more compensating in nature versus rural parents, who might be reinforcing in nature) to examine how such resource reallocation can influence child-quality.[71]

(2018) have only used height-for-age z-scores for 6–18 year old children but not for those who are below the age of five. Besides weight-for-age is also an important indicator of a child's health in the initial years of birth. In addition, these studies have neither examined heterogeneity in the Q-Q trade-off by different family sizes and types of family setting nor have used all the health indicators consistently for all age groups of children. This study aims to fill this gap in the literature.

[70] Birth spacing refers to age gap between the children. Smaller age gap between last two children has a direct negative impact on schooling outcomes of previous born children. Therefore, I control for this age-spacing between the first and last children in the regression models which controls for the care taken by the oldest child for younger siblings in a family.

[71] Compensating parents are likely to allocate resources evenly among all children whereas reinforcing parents

Chapter 3 contributes to the labour market economics literature both theoretically as well as empirically. It contributes to the theoretical model of Gronau (1977) by revising the Gronau-optimal time allocation by introducing a concept of *compulsory hours of housework time*. Using the theoretical framework, this study illustrates how an exogenous fertility shock may influence female labour market participation and hours of labour supply in the market. The endogeneity of fertility is controlled by using instruments (i.e., twins and first girl). The causal impacts of fertility on the labour market outcomes have never been examined in the earlier studies in the Indian context. Using twins from the IHDS-II dataset, the empirical findings reveal that fertility discourages female labour market participation and longer hours of labour supply, particularly when children are young (under the age of six) but school-aged children increases the likelihood of female labour market participation. This study focuses solely on those women who are working in paid jobs outside home. However, there are many unpaid work that women routinely do at home in family enterprises (such as livestock or poultry farming, fishing, supplying production in neighbourhood grocery stores, making small items for sale, growing fruit and vegetables for sale etc.). By engaging in these activities, women indirectly contributes to economic activity. It is not feasible to provide empirical insights for this set of women due to data limitation. As an agenda for further research, this analysis could be extended to understand the impact of fertility on the female *trichotomy of time allocation* in a developing country context. Such a study would require precise information on time spent by women on at least three of the core activities, namely housework, market-work and leisure (if sleep-time is excluded from the leisure time). This would be similar to what Gronau has done in a developed country context, i.e., in Israel and in the USA. In addition, complete information on husbands' labour market outcomes could make the study even more interesting as this will enable the comparison of labour market outcomes by gender, as motivated by Becker (1985).

Chapter 4 discusses on the Affirmative Action (AA) programme in India that intends to raise

are likely to allocate more resources on non-twin (better quality) children.

the likelihood of representation for the historically oppressed caste (SC) and tribal minority (ST) groups through obtaining a government job or getting into academic institutions (school/college). Belonging to the said communities does not automatically enable the members to benefit from the various central and state AA schemes. Rather, these disadvantaged groups are required to have a caste certificate from the government of their native state domicile.[72] This chapter investigates whether the possession of a caste certificate by an *eligible* member of a slum-dwelling household improves the household's standard of living, compared to similar *eligible* households that do not possess one. This slum-level study is a novel contribution to the literature on AA programmes and socio-economic well-being of disadvantaged groups of people in the India. We have used unique dataset comprising of 1,361 households residing in the urban slums of Mumbai and Kolkata, where larger shares of population residing in slums among all other Indian cities. The study controls for the endogeneity in the possession of caste certificates by using an instrument (i.e., whether the household is residing within its state of origin, where the registration of caste certificate is feasible).[73] The findings reveal that the benefits of the possession of a caste certificate on an *eligible* household's the standard of living are relevant to OBC households. The benefit of a caste certificate on an *eligible* household's standard of living is mediated through the procurement of government jobs, potentially through a reservation channel, by at least a household member. The primary limitation of this study is that we do not know whether or not government job holdings by the household members are secured through a reservation channel. In addition, this study has explored only one mediation channel, i.e., the procurement of government jobs through which caste certificate works effectively in improving the standard of living within a slum setting. As a future research agenda, it would also be interesting to explore an alternative mediation channel, such as reservation in higher education, within a slum setting.

[72]For one to be *eligible* for a caste certificate, a beneficiary's caste must be listed in the central or a state government's list of identified caste groups (or jatis) that are broadly classified into SC, ST and OBC.

[73]The need to register for a caste certificate is driven by the choice of an eligible candidate on whether to access government benefits through a reservation channel.

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Appendix

A2.1. Recent literature

Panel A: Twins			
Author	**Country**	**Outcome**	**Results**
Black et al. (2010)	Norway	IQ (Standardized 1-9) Completed High School	Negative Trade-off
Caceres-Delpiano (2006)	USA	Private School Attendance Educational Attainment	Negative Trade-off No Trade-off
Li et al. (2008)	China	Education Categories Education Enrolment	Trade-off in Rural areas
Ponczek and Souza (2012)	Brazil	Years of Education (Female) Years of Education (Male)	Negative Trade-off No Trade-off
Sanhueza (2009)	Chile	Years of Education	Negative Trade-off
Angrist et al. (2005, 2010)	Israel	Years of Education Some College College Grad	No Trade-off
Black et al. (2005)	Norway	Years of Education	No result with birth order
Dayioglu et al. (2009)	Turkey	Attendance	No Trade-off
Fitzsimons and Malde (2014)	Mexico	Years of Education (Female) Enrolment (Female)	No Trade-off

Continued...

Source: Summarised by the author.

Panel B: Gender Composition			
Author	**Country**	**Outcome**	**Results**
Becker et al. (2010)	Prussia	Enrolment	Negative Trade-off
Conley and Glauber (2006)	USA	Private School Attendance Grade Repetition	Negative Trade-off (Second born boy) No Association
Goux and Maurin (2005)	France	Held Back Grades	Positive impact on grade retention with higher no. of persons per room
Angrist et al. (2010)	Israel	Years of Education Some College College Graduation	No Trade-off
Black et al. (2005)	Norway	Years of Education	No Trade-off (positive result)
Panel C: Gender of First Child			
Kumar & Kugler (2017)	**India**	Years of Education Primary School Completion	Negative Trade-off
Lee (2008)	Taiwan	Total ln (Educational Spend)	Positive relation between dependent and outcome, especially when fertility is too high.
Panel D: Fertility Shock (Miscarriage)			
Maralani (2008)	Indonesia	Year of Education Completed Junior Secondary Entered Senior Secondary	Negative Trade-off in urban area
Panel E: Fertility Shock (Policy Effect)			
Bougma et al. (2015)	Burkina Faso	Years of Education	Negative Trade-off
Dang and Rogers (2013)	Vietnam	Years of Education Private Tutoring	No Trade-off Negative Trade-off
Hotz et al. (1997)	USA	Completed High-school	No Trade-off

Source: Summarised by the author.

A2.2. Sample

Out of 111,193 children in the birth history file, there are 79,073 children who are living with the eligible women respondent. The survey provides no additional information for children who are either dead or are living outside the household and hence are not considered in this analysis. The birth history file provided detail information on the month and the year of birth of children. I have dropped 39 children whose ages are negative, thus arriving at 79,034 children. Nineteen children are dropped due to missing information on households' religion, remaining with 79,015 children. One individual is misreported as a child and hence, the age has been corrected. This leads to 79,014 children. The information on education of children are available from the individual records and are merged with eligible women record. While merging the individual education file with eligible women file, two children are dropped due to mismatches, remaining with 79,012 children. Out of 79,012 children, 12,133 children (i.e., 15%) are not considered in this analysis because the age of these of children are not compatible with their completed years of schooling.[74] Twelve children have no information on completed years of schooling between the ages of 5–18. Besides, the data have missing information on medical treatment location. Dropping households with missing information, I finally consider a sample to 43,721 children between the ages of 5–18. This age cut-off is used to avoid sample selection problem, especially for girls, who generally get married at the age of 18. Out of 43,731 children 828 children have twin siblings and 42,903 children have non-twin siblings.

[74]Whether ages or the educational attainments are misspecified, it is difficult to analyse. Hence, I have dropped these households remaining with 66,879 children.

A2.3. Fertility rates for the IHDS-II women

Women Age IHDS-II	Average fertility IHDS-II	Standard error	Birth during	Live births per woman[1]
15–24	2.20	0.02	2011	2.3
25-34	2.86	0.01	2001	3.1
35-44	3.56	0.01	1991	3.8
45-54	4.13	0.02	1981	4.7
55-64	4.39	0.04	1971	5.4

Notes:[1]Data has been collected from The United Nations World Fertility Patterns 2013 accessed from https://www.un.org/en/development/desa/population/publications/pdf/fertility/world-fertility-patterns-2013.pdf on August 06, 2020.
Source: Estimated are based on author's own calculation using the IHDS-II dataset.

A2.4. State-wise fertility rates of IHDS-II women and average education of IHDS-II children

State-wise woman's average fertility	Mean years of schooling for child age 5-14	Standard error
States with average two children per woman	4.22	0.04
States with average three children per woman	3.79	0.02
States with average more than four per woman	2.65	0.03
Total number of children	32,093	

State-wise woman's average fertility	Mean years of schooling for child age 15-18	Standard error
States with average two children per woman	9.93	0.04
States with average three children per woman	8.77	0.03
States with average more than four per woman	7.49	0.06
Total number of children	11,638	

Notes:pairwise differences in average education by average fertility within each age group are statistically significant. Fertility by state is presented in Appendix Table A2.5 below.
Source: Estimated are based on author's own calculation using the IHDS-II dataset.

A2.5. State-wise average fertility rates

Indian states	Average fertility	Standard error
Maharashtra	2.95	0.02
Andhra Pradesh	2.81	0.02
Goa	2.38	0.05
Kerala	2.46	0.02
Tamil Nadu	2.62	0.03
Pondicherry	2.39	0.07
Sikkim	2.85	0.11
Manipur	2.82	0.15
Tripura	2.57	0.08
Chandigarh	2.81	0.12
Jammu & Kashmir	3.76	0.04
Himachal Pradesh	3.01	0.03
Punjab	3.13	0.02
Uttarakhand	3.89	0.06
Haryana	3.47	0.03
Delhi	3.47	0.04
Arunachal Pradesh	3.80	0.10
Mizoram	3.07	0.20
Assam	3.17	0.04
West Bengal	3.00	0.03
Jharkhand	3.62	0.05
Orissa	3.46	0.03
Chhattisgarh	3.58	0.03
Madhya Pradesh	3.72	0.02
Gujarat	3.24	0.03
Daman & Diu	3.74	0.11
Dadra & Nagar Havel	3.40	0.15
Karnataka	3.12	0.02
Rajasthan	4.08	0.03
Uttar Pradesh	4.59	0.02
Bihar	4.59	0.03
Meghalaya	4.32	0.15
Nagaland	4.02	0.16
Total number of women	63,427	

Notes: All IHDS-II women are considered for this table.
Source: Estimated are based on author's own calculation using the IHDS-II dataset.

A2.6. LMS z-score calculation

The calculation of z-score by WHO for all the growth indicators are based on LMS method (Cole and Green, 1992). The Z-scores are the standardized measures of growth indicators (y) and are used to identify whether a child has normal growth, or a child is at a risk of a health problem. The individual z-score for a measurement of y at age t is computed as,

$$Z_{ind} = \frac{y - M(t)}{(SD(t)} \tag{5.1}$$

Where y is a growth indicator, $M(t)$ is median at age t and $SD(t)$ is coefficient of variation or standard deviation at age t. For a child, when the z-score for a growth indicator is below -3 or above 3 then distribution of z-score may be skewed. LMS method is used to transform the skewed data to normal distribution for analytical simplification. Therefore, z-score is adjusted using LMS method and this LMS z-score (Z^*_{ind}) of the child for a given indicator is given by,

$$Z^*_{ind} = \begin{cases} Z_{ind} & \text{if} -3 \geq Z_{ind} \leq 3 \\ 3 + \frac{y - SD3pos}{SD23pos} & \text{if } Z_{ind} > 3 \\ -3 + \frac{y - SD3neg}{SD23neg} & \text{if } Z_{ind} < -3. \end{cases} \tag{5.2}$$

where,

SD3pos is the cut-off 3 SD calculated at age t by the LMS method;

SD3neg is the cut-off -3 SD calculated at age t by the LMS method;

SD23pos is the difference between the cut-offs 3 SD and 2 SD calculated at age t by LMS method;

SD23neg is the difference between the cut-offs -2 SD and -3 SD calculated at age t by LMS method;

For empirical analysis, I have used WHO Anthro and macros to calculate the z-scores of the children's nutritional variables.[75] This software uses LMS method as discussed above. IHDS-II dataset has anthropometry information for all eligible women and their children. Weight is reported in kilograms and height is given in centimetre. Therefore, to calculate BMI, all heights have been converted in metres. Using the WHO Anthro and macros, I have calculated the followings for all the growth indicators: i) z-scores, ii) whether z-scores are more than 2 standard deviation below median, and iii) whether z-scores are more than 3 standard deviation below median. These are calculated for two age categories of children namely 0-5 and 5-18.

[75]WHO Anthro and macros are downloaded from http://www.who.int/childgrowth/software/en/ and http://www.who.int/growthref/tools/en/

A2.7. Birth spacing

Years of Schooling Completed	3 Child Family	4 Child Family	5 Child Family
Child 1[a]	0.078**	0.279***	-0.031
Child 1 and 2[b]		0.155***	0.071
Child 1, 2 and 3[c]			0.070

Notes: ***p<0.01, **p<0.05, *p<0.1.Significance of coefficients is based on robust standard error. All regression includes indicators for child age, child gender, child gender*child age, mother's age, squared age of mother, mother education, social groups, state dummies, medical treatment location and age gaps of last two children. To tackle this birth spacing effect on education of children, I control for age gap between first and last child as an additional control in regression. I also control for contraceptive use as a robustness check. [a]First child's years of schooling. [b]First and second child's years of schooling, [c]First, second and third child's years of schooling.
Source: The estimates are based on the IHDS-II data.

A2.8. Effect of child-quantity on test scores (age 8–11)

Dependent variables:	OLS			2SLS		
	Read	Maths	Write	Read	Maths	Writing
No. of living children[1]	-0.021^{***}	-0.026^{***}	-0.027^{***}	0.018	-0.019	0.000
Observations	9,003	9,003	9,003	9,003	9,003	9,003
R-squared	0.109	0.160	0.141	0.087	0.140	0.154
Twins (Instrument)				0.915^{***}	0.915^{***}	0.915
R-squared				0.463	0.463	0.463
F-Statistic[2]				98	98	98
	With additional controls: age gap and birth order of children					
No. of living children[1]	-0.023^{***}	-0.029^{***}	-0.029^{***}	0.022	-0.019	0.005
Observations	9,003	9,003	9,003	9,003	9,003	9,003
R-squared	0.110	0.161	0.161	0.093	0.141	0.155
Twins (Instrument)				0.816^{***}	0.816^{***}	0.816
R-squared				0.688	0.688	0.688
F-Statistic[2]				134	134	134

Notes: $^{***}p<0.01$, $^{**}p<0.05$, $^{*}p<0.1$. Significance of coefficients is based on robust standard error. [1]Number of living children is instrumented with twins in 2SLS. [2]Kleibergen-Paap Wald F-statistic. The regression equations control for age of child, age of mother, square of age of mother, education of mother, child gender, child gender*child age, medical treatment location and state dummies, communities include Brahmin, FC-General, disadvantaged groups (SC, ST and OBC), FC-Muslim and Others (Christians, Sikhs and Jains) are considered as base categories.
Source: Estimates are based on author's own calculation using the IHDS-II dataset.

A2.9. First stage regression results: Twin birth order is used as instrument for number of children

	Edu. Yrs.	Attend[1].	Delay	ERT[2]	EDT[3]
Families with 2 or more children: Effect of **second order twin births** on No. of children					
Second order twins	0.787***	0.787***	0.787***	0.769***	0.769***
	(0.118)	(0.118)	(0.118)	(0.122)	(0.122)
No. of twins	62	62	62	62	62
R-squared	0.396	0.396	0.396	0.385	0.385
Observations	12,037	12,037	12,037	12,037	12,037
Families with 3 or more children: Effect of **third order twin births** on No. of children					
Third order twins	0.817***	0.817***	0.817***	0.819***	0.819***
	(0.128)	(0.128)	(0.128)	(0.129)	(0.129)
No. of twins	67	67	67	67	67
R-squared	0.335	0.335	0.335	0.335	0.335
Observations	11,668	11,668	11,668	11,668	11,668
Families with 4 or more children: Effect of **fourth order** twin births on No. of children					
Fourth order twins	0.786***	0.786***	0.786***	0.786***	0.786***
	(0.210)	(0.210)	(0.210)	(0.210)	(0.210)
No. of twins	27	27	27	27	27
R-squared	0.276	0.276	0.276	0.275	0.275
Observations	6,795	6,795	6,795	6,795	6,795
Families with 5 or more children: Effect of **fifth order twin births** on No. of children					
Fourth order twins	0.937***	0.937***	0.937***	0.944***	0.944***
	(0.184)	(0.184)	(0.184)	(0.187)	(0.187)
No. of twins	14	14	14	14	14
R-squared	0.262	0.262	0.262	0.262	0.262
Observations	3,377	3,377	3,377	3,377	3,377

Notes: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Standard errors are reported in parentheses.
Significance of coefficients is based on robust standard error. [1]Attendance is dummy variable: if children are absent for less than 15 days, attendance=1, provided they are enrolled in school. [2]ERT is completed years of schooling relative to expected years of schooling at any given age. [3]EDT is age standardised schooling index including twins. Regressions include age of child, age of mother, squared age of mother, education of mother, child gender, child gender*child age, state dummies, age gaps between twins and children born before twin birth, communities include Brahmin, FC-General, disadvantaged groups (SC, ST and OBC), FC-Muslim and Others (Christians, Sikhs and Jains) are considered as base categories. F-statistic is Kleibergen-Paap Wald F-statistic. Different size of family is considered to study the non-linear effect of family size on children's educational outcomes. In addition, the families that desire more children after the $n^{th}h$ twin birth may differ in characteristics depending upon whether the parents will end up with singletons or another pair of twins. To examine this possible differential effects, this table studies the effect of higher order twin births on all earlier children's education.
First stage regression results are reported in Appendix Table A2.9.
Source: Estimates are based on authors' calculations using the survey data.

A2.10. First stage regression results: Gender difference by settlement types

	Boy					Girl				
	Edu. Yrs.	Attend[1].	Delay	ERT[2]	EDT[3]	Edu. Yrs.	Attend.	Delay	ERT	EDT
First stage of 2SLS for **urban** sample (Number of children regressed on twin births)†										
Twin births	1.046***	1.046***	1.046***	1.025***	1.025***	1.034***	1.034***	1.034***	1.001***	1.001***
	(0.105)	(0.105)	(0.105)	(0.108)	(0.108)	(0.117)	(0.117)	(0.117)	(0.118)	(0.118)
No. of twins	124	124	124	124	124	125	125	125	125	125
R-squared	0.657	0.657	0.657	0.650	0.650	0.598	0.598	0.598	0.587	0.587
Observations	7,171	7,171	7,171	7,171	7,171	6,540	6,540	6,540	6,540	6,540
First stage of 2SLS for **rural** sample (Number of children regressed on twin births)†										
Twin births	0.838***	0.838***	0.838***	0.823***	0.823***	1.257***	1.257***	1.257***	1.257***	1.257***
	(0.068)	(0.068)	(0.068)	(0.068)	(0.068)	(0.081)	(0.081)	(0.081)	(0.083)	(0.083)
No. of twins	282	282	282	282	282	297	297	297	297	297
R-squared	0.578	0.578	0.578	0.574	0.574	0.527	0.527	0.527	0.518	0.518
Observations	15,682	15,682	15,682	15,682	15,682	14,338	14,338	14,338	14,338	14,338

Notes: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Standard errors are reported in parentheses.
Significance of coefficients is based on robust standard error. [1]Attendance is dummy variable: if children are absent for less than 15 days, attendance=1, provided they are enrolled in school. [2]ERT is completed years of schooling relative to expected years of schooling at any given age. [3]EDT is age standardised schooling index including twins. Regressions include age of child, age of mother, squared age of mother, education of mother, child gender, child gender*child age, state dummies, age gaps between twins and children born before twin birth, communities include Brahmin, FC-General, disadvantaged groups (SC, ST and OBC), FC-Muslim and Others (Christians, Sikhs and Jains) are considered as base categories. F-statistic is Kleibergen-Paap Wald F-statistic. Different size of family is considered to study the non-linear effect of family size on children's educational outcomes. In addition, the families that desire more children after the $n^{th}h$ twin birth may differ in characteristics depending upon whether the parents will end up with singletons or another pair of twins. To examine this possible differential effects, this table studies the effect of higher order twin births on all earlier children's education.
First stage regression results are reported in Appendix Table A2.9.
Source: Estimates are based on authors' calculations using the survey data.

A2.11. Descriptive statistics for IHDS-II children: Urban versus rural settlement

Child characteristics:	Overall		Mother Urban (1)			Mother Rural (2)			Mean Diff. (1)-(2)
	Mean	SD	Obs.	Mean	SD	Obs.	Mean	SD	p-value
Age of child (in Years)	11.78	3.94	13,711	12.05	3.94	30,020	11.65	3.93	0.00
Boy Proportion (0/1)	0.52	0.50	13,711	0.52	0.50	30,020	0.52	0.50	0.90
Child education (5-18 years):									
Years of schooling	4.93	3.59	13,711	5.34	3.69	30,020	4.73	3.52	0.00
School attendance	0.78	0.42	13,711	0.80	0.40	30,020	0.77	0.42	0.00
Delay in years of schooling	0.28	0.45	13,711	0.25	0.44	30,020	0.29	0.45	0.00
Expected to actual years of schooling (ERT)	0.59	0.31	13,711	0.62	0.30	30,020	0.57	0.31	0.00
Age-standardised schooling index (EDT)	1.00	0.74	13,711	1.03	0.71	30,020	0.98	0.76	0.00
Child test scores (8-11 years):									
Reading	0.89	0.31	2,720	0.94	0.24	6,283	0.87	0.34	0.00
Maths	0.85	0.36	2,720	0.92	0.27	6,283	0.81	0.39	0.00
Write	0.75	0.43	2,720	0.84	0.37	6,283	0.72	0.45	0.00

Source: Estimated are based on author's own calculation using the IHDS-II dataset.

A2.12. Descriptive statistics for IHDS-II women and households: Urban versus rural settlement

	Overall		Mother Urban (1)			Mother Rural (2)			Mean Diff. (1)-(2)
Mother characteristics	Mean	SD	Obs.	Mean	SD.	Obs.	Mean	SD	p-value
Age of mother (in years)	36.39	6.56	13,711	36.67	6.21	30,020	36.27	6.71	0.00
Education (in years)	4.23	4.65	13,711	6.37	5.06	30,020	3.25	4.11	0.00
No. of living children	3.50	1.65	13,711	3.15	1.54	30,020	3.66	1.67	0.00
Household characteristics:									
Household size [1]	6.13	2.41	13,711	5.88	2.32	30,020	6.24	2.45	0.00
Medical treatment location[2]	1.69	0.94	13,711	1.37	0.86	30,020	1.84	0.94	0.00
Household assets [3]	14.81	6.39	13,711	19.21	5.28	30,020	12.79	5.82	0.00
Income per capita (in INR)[†]	20,561	36252	13,711	28,839	40,750	30,020	16,780	33,324	0.00
Consumption per capita (in INR)[†]	21,226	20,843	13,711	27,703	24,647	30,020	18,267	18,095	0.00
Religious/social groups:									
Brahmin (0/1)	0.04	0.20	13,711	0.06	0.23	30,020	0.04	0.19	0.00
FC (0/1)	0.14	0.34	13,711	0.17	0.37	30,020	0.12	0.33	0.00
Disadv. group (0/1)[4]	0.64	0.47	13,711	0.53	0.50	30,020	0.69	0.46	0.00
Muslim (0/1)	0.16	0.36	13,711	0.22	0.41	30,020	0.13	0.33	0.00
Others (0/1)[5]	0.02	0.14	13,711	0.02	0.17	30,020	0.02	0.13	0.00

Notes: [1]Household size refers to number of members in a household. [2]Medical treatment location has four categories depending on its distance. Higher category means higher distance. [3]Household Assets contain information on number of assets that a household has. The number ranges from 0 to 33. [4]Disadvantaged group includes Other Backward Class, Dalit and Adivasi. [5]Others include – Christian, Sikh and Jain. [†]One dollar is equal to 71.04 Indian rupees as of January 19, 2020.
Source: Estimated are based on author's own calculation using the IHDS-II dataset.

A2.13. Descriptive statistics for IHDS-II children: Extended versus nuclear family

Child characteristics:	Overall		Mother Nuclear Family (1)			Mother Extended Family (2)			Mean Diff. (1)-(2)
	Mean	SD	Obs.	Mean	SD	Obs.	Mean	SD	p-value
Age of child (in Years)	11.78	3.94	20,254	11.71	3.89	23,477	11.83	4.00	0.00
Boy Proportion (0/1)	0.52	0.50	20,254	0.52	0.50	23,477	0.53	0.50	0.01
Child education (5-18 years):									
Years of schooling	4.93	3.59	20,254	4.97	3.58	23,477	4.89	3.59	0.03
School attendance	0.78	0.42	20,254	0.79	0.41	23,477	0.76	0.42	0.00
Delay in years of schooling	0.28	0.45	20,254	0.27	0.45	23,477	0.28	0.45	0.01
Expected to actual years of schooling (ERT)	0.59	0.31	20,254	0.60	0.31	23,477	0.58	0.31	0.00
Age-standardised schooling index (EDT)	1.00	0.74	20,254	1.01	0.74	23,477	0.99	0.75	0.00
Child test scores (8-11 years):									
Reading	0.89	0.31	4,321	0.89	0.31	4,682	0.89	0.31	0.73
Maths	0.85	0.36	4,321	0.85	0.36	4,682	0.84	0.36	0.83
Write	0.75	0.43	4,321	0.75	0.43	4,682	0.76	0.43	0.39

Source: Estimated are based on author's own calculation using the IHDS-II dataset.

A2.14. Descriptive statistics for IHDS-II women and households: Extended versus nuclear family

	Overall		Mother Nuclear Family (1)			Mother Extended Family (2)			Mean Diff. (1)-(2)
Mother characteristics	Mean	SD	Obs.	Mean	SD.	Obs.	Mean	SD	p-value
Age of mother (in years)	36.39	6.56	20,254	35.51	5.75	23,477	37.15	7.10	0.00
Education (in years)	4.23	4.65	20,254	4.23	4.58	23,477	4.23	4.72	0.95
No. of living children	3.50	1.65	20,254	3.29	1.44	23,477	3.68	1.79	0.00
From urban area	0.31	0.46	20,254	0.35	0.48	23,477	0.29	0.45	0.00
Household characteristics:									
Household size [1]	6.13	2.41	20,254	5.20	1.46	23,477	6.92	2.76	0.00
Medical treatment location[2]	1.69	0.94	20,254	1.67	0.93	23,477	1.71	0.95	0.00
Household assets [3]	14.81	6.39	20,254	14.43	6.30	23,477	15.13	6.46	0.00
Income per capita (in INR)†	20,561	36252	20,254	19,897	30,232	23,477	21,134	40,729	0.00
Consumption per capita (in INR)†	21,226	20,843	20,254	21,726	20,448	23,477	20,794	21,168	0.00
Religious/social groups:									
Brahmin (0/1)	0.04	0.20	20,254	0.04	0.19	23,477	0.05	0.21	0.00
FC (0/1)	0.14	0.34	20,254	0.13	0.33	23,477	0.15	0.35	0.00
Disadv. group (0/1)[4]	0.64	0.47	20,254	0.65	0.48	23,477	0.63	0.48	0.00
Muslim (0/1)	0.16	0.36	20,254	0.16	0.37	23,477	0.15	0.36	0.00
Others (0/1)[5]	0.02	0.14	20,254	0.02	0.14	23,477	0.02	0.15	0.00

Notes: [1]Household size refers to number of members in a household. [2]Medical treatment location has four categories depending on its distance. Higher category means higher distance. [3]Household Assets contain information on number of assets that a household has. The number ranges from 0 to 33. [4]Disadvantaged group includes Other Backward Class, Dalit and Adivasi. [5]Others include – Christian, Sikh and Jain. †One dollar is equal to 71.04 Indian rupees as of January 19, 2020.
Source: Estimated are based on author's own calculation using the IHDS-II dataset.

A2.15. Robustness check with additional control variables

Table 5.1: Robustness check with additional control variables

	With age gap control					With control for contraceptive use by either parent				
	Edu. Yrs.	Attend[1].	Delay	ERT[2]	EDT[3]	Edu. Yrs.	Attend.	Delay	ERT	EDT
OLS (Education indicators regressed on No. of children)										
No. of children	-0.200***	-0.022***	0.002	-0.011***	-0.022***	-0.240***	-0.019***	0.005***	-0.007***	-0.022***
	(0.011)	(0.002)	(0.002)	(0.001)	(0.003)	(0.010)	(0.002)	(0.002)	(0.001)	(0.003)
R-squared	0.771	0.086	0.119	0.240	0.075	0.770	0.087	0.118	0.241	0.075
First stage of 2SLS (No. of children regressed on twin births)†										
Twin births	0.974***	0.974***	0.974***	0.967***	0.967***	1.053***	1.053***	1.053***	1.040***	1.040***
	(0.041)	(0.041)	(0.041)	(0.041)	(0.041)	(0.045)	(0.045)	(0.045)	(0.046)	(0.046)
R-squared	0.661	0.661	0.661	0.659	0.659	0.575	0.575	0.575	0.569	0.569
No. of twins	828	828	828	828	828	828	828	828	828	828
Second stage of 2SLS (Education indicators regressed on No. of children)										
No. of children	-0.096	-0.039***	-0.011	-0.017*	-0.004	-0.122*	-0.038***	-0.009	-0.016*	-0.006
	(0.068)	(0.015)	(0.015)	(0.010)	(0.026)	(0.063)	(0.014)	(0.014)	(0.009)	(0.024)
F-Statistic	567	567	567	552	552	543	543	543	512	512
Observations	43,731	43,731	43,731	43,731	43,731	43,731	43,731	43,731	43,731	43,731

Notes: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Standard errors are reported in parentheses.
Significance of coefficients is based on robust standard error.
[1]Attendance is dummy variable - children who are absent for less than 15 days: attendance=1, provided they are enrolled in school. [1]2ERT is completed years of schooling relative to expected years of schooling at any given age. [1]3EDT is age standardized schooling index including twins. The regression controls for age of child, age of mother, education of mother, child gender, child gender*child age, medical treatment location, state dummies, dummies for birth order of children, communities include Brahmin, FC-General, disadvantaged groups (SC, ST and OBC), FC-Muslim and Others (Christians, Sikhs and Jains) are considered as base categories.†Number of children is instrumented with twins in 2SLS regression. Age gap refers to age gap between the first child and the last child. F-Statistic is Kleibergen-Paap Wald F statistic.
Source: Estimates are based on authors' calculations using the survey data.

A2.16. Same gender composition of first two children: An alternative instrument

	2SLS: Twin births (instrument)					2SLS: Same-gender of first two children (instrument)				
	Edu. Yrs.	Attend[1].	Delay	ERT[2]	EDT[3]	Edu. Yrs.	Attend.	Delay	ERT	EDT
Second stage of 2SLS (Education indicators regressed on No. of children)										
No. of children	-0.124*	-0.032**	0.000	-0.020**	-0.011	-0.622***	-0.042*	-0.023	-0.043***	-0.082**
	(0.066)	(0.015)	(0.015)	(0.010)	(0.025)	(0.105)	(0.023)	(0.025)	(0.015)	(0.038)
R-squared	0.765	0.094	0.117	0.255	0.077	0.755	0.092	0.112	0.245	0.071
F-statistics	465.725	465.725	465.725	443.360	443.360	254.612	254.612	254.612	257.454	257.454
First stage of 2SLS (No. of children regressed on Instument)†										
Twin births	1.008***	1.008***	1.008***	0.997***	0.997***					
	(0.047)	(0.047)	(0.047)	(0.047)	(0.047)					
Same-gender of first two						0.174***	0.174***	0.174***	0.175***	0.175***
						(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
No. of instruments	828	828	828	828	828	19,402	19,402	19,402	19,402	19,402
R-squared	0.581	0.581	0.581	0.578	0.578	0.577	0.577	0.577	0.574	0.574
Observations	42,069	42,069	42,069	42,069	42,069	42,069	42,069	42,069	42,069	42,069

Notes: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Standard errors are reported in parentheses.
Significance of coefficients is based on robust standard error.
[1]Attendance is dummy variable: children who are absent for less than 15 days in a month: attendance=1, provided they are enrolled in school. ERT is completed years of schooling relative to expected years of schooling at any given age. EDT is age standardized education; Number of living children is instrumented using twin births and same-gender of first two children. Regressions include age of child, age of mother, square of age of mother, education of mother, child gender, child gender*child age, medical treatment location and state dummies, dummies for birth order of children, communities include Brahmin, FC-General, disadvantaged groups (SC, ST and OBC), FC-Muslim and Others (Christians, Sikhs and Jains) are considered as base categories. Mothers who have at least two children are considered in this sample. Kleibergen-Paap Wald F-statistic are reported.
Source: Estimates are based on authors' calculations using the survey data.

A2.17. Included versus missing z-scores for 1–4 year children's weight-for-age

	Included sample			Missing sample			Mean difference	
	1-4-year-old children (1)			1-4-year-old children (2)			(2-1)	
Child characteristics:	Obs.	Mean	SD	Obs.	Mean	SD	(p-values)	
Z-score: weight-for-age	2,350	-1.58	1.35					
Age of child (in years)	2,350	4.34	0.32	369	4.37	0.33	0.02	(0.21)
Boy proportion	2,350	0.54	0.50	369	0.50	0.50	-0.04	(0.15)
Mother characteristics:								
Age of mother (in years)	2,350	29.14	5.03	369	28.68	4.82	-0.46	(0.10)
Education (in years)	2,350	5.43	4.94	369	6.14	4.76	0.71	(0.01)
Number of children	2,350	2.85	1.49	369	2.57	1.13	-0.28	(0.00)
From urban area	2,350	0.30	0.46	369	0.30	0.46	0.01	(0.84)
Household characteristics								
Household size[1]	2,350	6.34	2.53	369	6.89	3.02	0.55	(0.00)
Medical treatment location[2]	2,350	1.71	0.97	369	1.76	0.94	0.05	(0.38)
Household assets[3]	2,349	14.48	6.58	369	15.38	6.12	0.90	(0.01)
Income per capita (in INR)[4]	2,350	19,858	33,931	369	18,944	18,428	- 914	(0.61)
Consumption per capita (in INR)	2,349	18,773	15,262	369	18,838	13,679	65	(0.94)
Religious/social groups								
Brahmins (0/1)	2,350	0.04	0.20	0.20	0.02	0.15	-0.02	(0.06)
FC (0/1)	2,350	0.12	0.33	0.33	0.16	0.37	0.04	(0.04)
Disadvantaged group (0/1) [5]	2,350	0.65	0.48	0.48	0.59	0.49	-0.06	(0.02)
Muslims (0/1)	2,350	0.16	0.37	0.37	0.20	0.40	0.04	(0.04)
Others (0/1)[6]	2,350	0.02	0.13	0.13	0.02	0.15	0.00	(0.66)

Notes: In the last column, the figures within parentheses are p-values. [1]Household size refers to number of members in a household. [2]Medical treatment location has 4 categories depending on its distance. Higher category means higher distance. [3]Household Assets contain information on number of assets that a household has. The number ranges from 0 to 33. [4]One dollar is equal to 71.04 Indian rupees as of January 19, 2020. [5]Disadvantaged group includes Other Backward Class, Dalit and Adivasi. [6]Others include – Christian, Sikh and Jain.
Source: Estimated are based on author's own calculation using the IHDS-II dataset.
Source: Estimated are based on author's own calculation using the IHDS-II dataset.

A2.18. Included versus missing z-scores for 1–4 year children's height-for-age

	Included sample 1-4-year-old children (1)			Missing sample 1-4-year-old children (2)			Mean difference (2-1) (p-values)	
Child characteristics:	Obs.	Mean	SD	Obs.	Mean	SD		
Z-score: height-for-age	2,173	-1.55	1.29					
Age of child (in years)	2,184	4.35	0.32	535	4.35	0.32	0.01	(0.66)
Boy proportion	2,184	0.54	0.50	535	0.49	0.50	-0.06	(0.02)
Mother characteristics:								
Age of mother (in years)	2,184	29.14	5.07	535	28.79	4.74	-0.35	(0.15)
Education (in years)	2,184	5.35	4.95	535	6.23	4.77	0.88	(0.00)
Number of children	2,184	2.87	1.49	535	2.58	1.23	-0.29	(0.00)
From urban area	2,184	0.30	0.46	535	0.31	0.46	0.01	(0.53)
Household characteristics								
Household size[1]	2,184	6.37	2.56	535	6.59	2.77	0.22	(0.08)
Medical treatment location[2]	2,184	1.70	0.95	535	1.79	1.00	0.09	(0.06)
Household assets[3]	2,183	14.43	6.61	535	15.30	6.13	0.88	(0.01)
Income per capita (in INR)[4]	2,184	19,732	34,751	535	19,739	19,028	7	(1.00)
Consumption per capita (in INR)	2,183	18,762	15,503	535	18,863	13,081	101	(0.89)
Religious/social groups								
Brahmins (0/1)	2,184	0.04	0.20	0.20	0.02	0.15	-0.02	(0.04)
FC (0/1)	2,184	0.12	0.33	0.33	0.16	0.36	0.03	(0.05)
Disadvantaged group (0/1) [5]	2,184	0.65	0.48	0.48	0.61	0.49	-0.04	(0.07)
Muslims (0/1)	2,184	0.16	0.37	0.37	0.19	0.39	0.02	(0.17)
Others (0/1)[6]	2,184	0.02	0.13	0.13	0.02	0.15	0.00	(0.48)

Notes: In the last column, the figures within parentheses are p-values. [1]Household size refers to number of members in a household. [2]Medical treatment location has 4 categories depending on its distance. Higher category means higher distance. [3]Household Assets contain information on number of assets that a household has. The number ranges from 0 to 33. [4]One dollar is equal to 71.04 Indian rupees as of January 19, 2020. [5]Disadvantaged group includes Other Backward Class, Dalit and Adivasi. [6]Others include – Christian, Sikh and Jain.
Source: Estimated are based on author's own calculation using the IHDS-II dataset.
Source: Estimated are based on author's own calculation using the IHDS-II dataset.

A2.19. Included versus missing z-scores for 1–4 year children's BMI-for-age

	Included sample 1-4-year-old children (1)			Missing sample 1-4-year-old children (2)			Mean difference (2-1) (p-values)	
Child characteristics:	Obs.	Mean	SD	Obs.	Mean	SD		
Z-score: BMI-for-age	2,160	-1.64	1.18					
Age of child (in years)	2,161	4.35	0.32	558	4.34	0.32	-0.01	(0.41)
Boy proportion	2,161	0.53	0.50	558	0.52	0.50	-0.02	(0.44)
Mother characteristics:								
Age of mother (in years)	2,161	29.15	5.07	558	28.78	4.75	-0.38	(0.11)
Education (in years)	2,161	5.34	4.94	558	6.24	4.78	0.91	(0.00)
Number of children	2,161	2.89	1.51	558	2.51	1.15	-0.38	(0.00)
From urban area	2,161	0.29	0.45	558	0.33	0.47	0.04	(0.09)
Household characteristics								
Household size[1]	2,161	6.37	2.55	558	6.59	2.79	0.22	(0.07)
Medical treatment location[2]	2,161	1.71	0.96	558	1.73	0.97	0.02	(0.70)
Household assets[3]	2,160	14.35	6.61	558	15.57	6.10	1.22	(0.00)
Income per capita (in INR)[4]	2,161	19,264	33,456	558	21,555	27,120	2,291	(0.13)
Consumption per capita (in INR)	2,160	18,651	15,490	558	19,287	13,235	636	(0.37)
Religious/social groups								
Brahmins (0/1)	2,161	0.04	0.21	0.21	0.02	0.15	-0.02	(0.03)
FC (0/1)	2,161	0.12	0.33	0.33	0.16	0.37	0.04	(0.02)
Disadvantaged group (0/1) [5]	2,161	0.65	0.48	0.48	0.61	0.49	-0.05	(0.03)
Muslims (0/1)	2,161	0.16	0.37	0.37	0.19	0.39	0.03	(0.10)
Others (0/1)[6]	2,161	0.02	0.13	0.13	0.02	0.15	0.00	(0.59)

Notes: In the last column, the figures within parentheses are p-values. [1]Household size refers to number of members in a household. [2]Medical treatment location has 4 categories depending on its distance. Higher category means higher distance. [3]Household Assets contain information on number of assets that a household has. The number ranges from 0 to 33. [4]One dollar is equal to 71.04 Indian rupees as of January 19, 2020. [5]Disadvantaged group includes Other Backward Class, Dalit and Adivasi. [6]Others include – Christian, Sikh and Jain.
Source: Estimated are based on author's own calculation using the IHDS-II dataset.
Source: Estimated are based on author's own calculation using the IHDS-II dataset.

A2.20. Included versus missing z-scores for 5–18 year children's weight-for-age

	Included sample			Missing sample			Mean	
	5-18- year-old children			5-18- year-old children			difference	
	(1)			(2)			(2-1)	
Child characteristics:	Obs.	Mean	SD	Obs.	Mean	SD	(p-values)	
Z-score: weight-for-age	14,336	-1.55	1.40					
Age of child (in years)	14,336	7.58	1.56	2,421	7.55	1.56	-0.03	(0.33)
Boy proportion	14,336	0.52	0.50	2,421	0.52	0.50	0.00	(0.92)
Mother characteristics:								
Age of mother (in years)	14,336	32.46	5.69	2,421	31.83	5.42	-0.63	(0.00)
Education (in years)	14,336	4.63	4.78	2,421	5.03	4.89	0.40	(0.00)
Number of children	14,336	3.29	1.59	2,421	3.07	1.48	-0.21	(0.00)
From urban area	14,336	0.28	0.45	2,421	0.31	0.46	0.03	(0.01)
Household characteristics								
Household size[1]	14,336	6.35	2.52	2,421	6.54	2.72	0.19	(0.00)
Medical treatment location[2]	14,336	1.69	0.94	2,421	1.69	0.94	0.00	(0.81)
Household assets[3]	14,332	14.10	6.51	2,420	14.65	6.45	0.56	(0.00)
Income per capita (in INR)[4]	14,336	18,323	27,752	2,421	20,125	26,755	1,802	(0.00)
Consumption per capita (in INR)	14,332	18,643	15,208	2,421	19,344	16,707	701	(0.04)
Religious/social groups								
Brahmins (0/1)	14,336	0.04	0.20	0.20	0.03	0.17	-0.01	(0.01)
FC (0/1)	14,336	0.12	0.33	0.33	0.14	0.35	0.02	(0.02)
Disadvantaged group (0/1) [5]	14,336	0.66	0.47	0.47	0.61	0.49	-0.05	(0.00)
Muslims (0/1)	14,336	0.16	0.37	0.37	0.20	0.40	0.04	(0.00)
Others (0/1)[6]	14,336	0.02	0.13	0.13	0.02	0.13	0.00	(0.88)

Notes: In the last column, the figures within parentheses are p-values. [1]Household size refers to number of members in a household. [2]Medical treatment location has 4 categories depending on its distance. Higher category means higher distance. [3]Household Assets contain information on number of assets that a household has. The number ranges from 0 to 33. [4]One dollar is equal to 71.04 Indian rupees as of January 19, 2020. [5]Disadvantaged group includes Other Backward Class, Dalit and Adivasi. [6]Others include – Christian, Sikh and Jain. Source: Estimated are based on author's own calculation using the IHDS-II dataset.
Source: Estimated are based on author's own calculation using the IHDS-II dataset.

A2.21. Included versus missing z-scores for 5–18 year children's height-for-age

	Included sample			Missing sample			Mean difference	
	5-18- year-old children (1)			5-18- year-old children (2)			(2-1)	
Child characteristics:	Obs.	Mean	SD	Obs.	Mean	SD	(p-values)	
Z-score: height-for-age	35,281	-1.55	1.44					
Age of child (in years)	35,281	11.71	3.92	8,450	12.06	4.00	0.35	(0.00)
Boy proportion	35,281	0.51	0.50	8,450	0.57	0.49	0.06	(0.00)
Mother characteristics:								
Age of mother (in years)	35,281	36.33	6.50	8450	36.65	6.82	0.32	(0.00)
Education (in years)	35,281	4.19	4.64	8450	4.37	4.73	0.18	(0.00)
Number of children	35,281	3.51	1.65	8450	3.43	1.65	-0.09	(0.00)
From urban area	35,281	0.31	0.46	8450	0.33	0.47	0.02	(0.00)
Household characteristics								
Household size[1]	35,281	6.12	2.39	8450	6.17	2.52	0.05	(0.07)
Medical treatment location[2]	35,281	1.69	0.94	8450	1.69	0.94	0.00	(0.72)
Household assets[3]	35,275	14.76	6.41	8443	14.98	6.31	0.22	(0.01)
Income per capita (in INR)[4]	35,281	20,151	33,839	8450	22,273	44,909	2,122	(0.00)
Consumption per capita (in INR)	35,276	21,092	19,997	8447	21,785	24,048	692	(0.01)
Religious/social groups								
Brahmins (0/1)	35,281	0.05	0.21	8450	0.03	0.17	-0.02	(0.00)
FC (0/1)	35,281	0.13	0.34	8450	0.14	0.35	0.01	(0.08)
Disadvantaged group (0/1) [5]	35,281	0.65	0.48	8450	0.61	0.49	-0.04	(0.00)
Muslims (0/1)	35,281	0.15	0.35	8450	0.19	0.39	0.04	(0.00)
Others (0/1)[6]	35,281	0.02	0.14	8450	0.02	0.15	0.00	(0.77)

Notes: In the last column, the figures within parentheses are p-values. [1]Household size refers to number of members in a household. [2]Medical treatment location has 4 categories depending on its distance. Higher category means higher distance. [3]Household Assets contain information on number of assets that a household has. The number ranges from 0 to 33. [4]One dollar is equal to 71.04 Indian rupees as of January 19, 2020. [5]Disadvantaged group includes Other Backward Class, Dalit and Adivasi. [6]Others include – Christian, Sikh and Jain. Source: Estimated are based on author's own calculation using the IHDS-II dataset.

Source: Estimated are based on author's own calculation using the IHDS-II dataset.

A2.22. Included versus missing z-scores for 5–18 year children's BMI-for-age

	Included sample 5-18- year-old children (1)			Missing sample 5-18- year-old children (2)			Mean difference (2-1) (p-values)	
Child characteristics:	Obs.	Mean	SD	Obs.	Mean	SD		
Z-score: BMI-for-age	34,849	-1.57	1.41					
Age of child (in years)	35,278	11.72	3.91	8,453	12.01	4.04	0.29	(0.00)
Boy proportion	35,278	0.51	0.50	8,453	0.58	0.49	0.07	(0.00)
Mother characteristics:								
Age of mother (in years)	35,278	36.34	6.49	8,453	36.60	6.83	0.25	(0.00)
Education (in years)	35,278	4.20	4.64	8,453	4.36	4.72	0.16	(0.01)
Number of children	35,278	3.51	1.65	8,453	3.43	1.65	-0.09	(0.00)
From urban area	35,278	0.31	0.46	8,453	0.33	0.47	0.02	(0.00)
Household characteristics								
Household size[1]	35,278	6.11	2.38	8,453	6.18	2.54	0.07	(0.02)
Medical treatment location[2]	35,278	1.69	0.94	8,453	1.69	0.94	0.01	(0.62)
Household assets[3]	35,271	14.77	6.41	8,447	14.97	6.31	0.20	(0.01)
Income per capita (in INR)[4]	35,278	20,193	33,856	8,453	22,098	44,861	1,906	(0.00)
Consumption per capita (in INR)	35,272	21,086	19,998	8,451	21,808	24,042	722	(0.00)
Religious/social groups								
Brahmins (0/1)	35,278	0.05	0.21	8,453	0.03	0.17	-0.02	(0.00)
FC (0/1)	35,278	0.13	0.34	8,453	0.14	0.35	0.01	(0.02)
Disadvantaged group (0/1) [5]	35,278	0.65	0.48	8,453	0.61	0.49	-0.04	(0.00)
Muslims (0/1)	35,278	0.15	0.36	8,453	0.19	0.39	0.04	(0.00)
Others (0/1)[6]	35,278	0.02	0.14	8,453	0.02	0.14	0.00	(0.89)

Notes: In the last column, the figures within parentheses are p-values. [1]Household size refers to number of members in a household. [2]Medical treatment location has 4 categories depending on its distance. Higher category means higher distance. [3]Household Assets contain information on number of assets that a household has. The number ranges from 0 to 33. [4]One dollar is equal to 71.04 Indian rupees as of January 19, 2020. [5]Disadvantaged group includes Other Backward Class, Dalit and Adivasi. [6]Others include – Christian, Sikh and Jain. Source: Estimated are based on author's own calculation using the IHDS-II dataset.

Source: Estimated are based on author's own calculation using the IHDS-II dataset.

A3.23. Derivation of first order conditions in the Gronau model

I derive the first order conditions for optimal time allocation. The choice variables in this model are: X_M, L, N, H, λ and μ. The first order conditions for the unconstrained maximum of L is given as follows:

Differentiating with respect to L:

$$\frac{\partial \mathcal{L}}{\partial L} = 0 \implies U_L = \mu \tag{A3.1}$$

Differentiating with respect to X_M:

$$\frac{\partial \mathcal{L}}{\partial X_M} = 0 \implies U_X = \lambda \tag{A3.2}$$

Differentiating with respect to H where $X = X_M + f(H)$:

$$\frac{\partial \mathcal{L}}{\partial H} = 0 \implies U_X f_H = \mu \tag{A3.3}$$

Differentiating with respect to N:

$$\frac{\partial \mathcal{L}}{\partial N} = 0 \implies \lambda W = \mu \tag{A3.4}$$

From Equation (A3.1) and (A3.2)

$$\frac{U_L}{U_X} = \frac{\mu}{\lambda} \tag{A3.5}$$

where $\frac{U_L}{U_X} = MRS_{X,L}$ which is the marginal rate of substitution between X and leisure hours L.

From Equation (A3.2) and (A3.3)

$$f_H = \frac{\mu}{\lambda} \tag{A3.6}$$

From Equation (A3.4)

$$W = \frac{\mu}{\lambda} \tag{A3.7}$$

A3.24. Second order condition for Gronau-equilibrium

The second order condition for Gronau-equilibrium can be examined using Bordered Hessian matrix for the constrained optimization exercise. Bordered Hessian matrix can be written as,

$$\bar{H} = \bar{H}_6 = \begin{bmatrix} 0 & 0 & T_{X_M} & T_L & T_H & T_N \\ 0 & 0 & X_{M_{X_M}} & X_{M_L} & X_{M_H} & X_{M_N} \\ T_{X_M} & X_{M_{X_M}} & \mathcal{L}_{X_M X_M} & \mathcal{L}_{X_M L} & \mathcal{L}_{X_M H} & \mathcal{L}_{X_M N} \\ T_L & X_{M_L} & \mathcal{L}_{L X_M} & \mathcal{L}_{LL} & \mathcal{L}_{LH} & \mathcal{L}_{N} \\ T_H & X_{M_H} & \mathcal{L}_{H X_M} & \mathcal{L}_{HL} & \mathcal{L}_{HH} & \mathcal{L}_{HN} \\ T_N & X_{M_N} & \mathcal{L}_{N X_M} & \mathcal{L}_{NL} & \mathcal{L}_{NH} & \mathcal{L}_{NN} \end{bmatrix}$$

where X_M is the income constraint and T is time constraint. In the above Lagrangian expression, there are four choice variables $(n = 4)$ namely, X_M, L, H, N and two constraints $(m = 2)$. Therefore, $n - m = 2$. To obtain maximum in constrained optimisation, the last 2 principal minors of the bordered Hessian matrix $\bar{H}$ must alternate in signs, the first having sign $(-1)^(m + 1)$ i.e., condition for maximum requires the determinant of $\bar{H}_5 < 0$ and determinant of $\bar{H}_6 > 0$. Similarly, condition for minimum requires the last $n-m$ principal minors must all be negative.

A3.25. Female labour force participation in India since 1987

	1987	1993	1999	2004	2009	2011
Urban (age 15-64)						
Principal status (PS)	10.8 (0.20)	13.7 (0.20)	15.0 (0.19)	19.4 (0.21)	19.6 (0.18)	22.2 (0.19)
PS + Subsidiary status	13.4 (0.25)	17.1 (0.25)	17.5 (0.22)	23.3 (0.26)	22.2 (0.21)	25.7 (0.22)
Urban (age 25-54)						
Principal status (PS)	7.1 (0.23)	9.5 (0.23)	10.8 (0.22)	13.9 (0.25)	14.3 (0.21)	16.6 (0.22)
PS + Subsidiary status	8.9 (0.28)	11.9 (0.29)	12.6 (0.26)	16.5 (0.30)	16.3 (0.24)	19.2 (0.26)
Rural (age 15-64)						
Principal status (PS)	71.6 (0.40)	74.4 (0.37)	82.6 (0.37)	97.0 (0.39)	84.0 (0.31)	74.1 (0.27)
PS + Subsidiary status	92.1 (0.52)	104.0 (0.51)	106.4 (0.48)	129.3 (0.52)	107.1 (0.39)	103.6 (0.37)
Rural (age 25-54)						
Principal status (PS)	47.0 (0.45)	49.8 (0.41)	57.4 (0.42)	68.3 (0.45)	60.0 (0.36)	54.2 (0.32)
PS + Subsidiary status	60.0 (0.57)	69.9 (0.58)	74.0 (0.55)	90.4 (0.59)	77.3 (0.46)	75.4 (0.44)

Notes: Numbers in millions and labour force participation rates in parenthesis. The principal status of a person is the status on which a person has spent relatively long time during the 365 days. Any engagement in subsidiary capacity may arise if a person may be engaged for a principal status and for a relatively small period, which is not less than 30 days, in another economic activity.
Source: Figures are taken from Klasen and Pieters (2015), Appendix S1 Table S1.1.

A3.26. Education of IHDS–II women by employment sectors

Employment sector	Overall				
	No edu (%)	Primary (%)	Sec. edu (%)	Post sec. (%)	Grad. (%)
Participation rate (%)	39.43	30.08	5.86	13.67	23.49
Agriculture	61.29	54.38	42.99	14.16	
Business	22.02	21.14	16.79	12.39	3.96
Official	2.28	5.01	14.33	50.88	87.79
Manufacturing	7.73	11.13	15.19	8.41	2.64
Other	6.67	8.34	10.70	14.16	5.61
Total(%)	100.00	100.00	100.00	100.00	100.00
Total participation	1,798	719	935	226	303
Total by education	4,560	2,390	5,897	1,653	1,290
	Urban				
Employment sector	No edu (%)	Primary (%)	Sec. edu (%)	Post sec. (%)	Grad. (%)
Participation rate (%)	30.56	20.16	10.93	11.05	23.09
Agriculture	22.76	16.80	9.35	2.15	
Business	19.92	17.60	10.57	7.53	4.74
Official	4.07	4.80	20.73	55.91	85.78
Manufacturing	19.92	25.60	31.71	12.90	3.79
Other	33.33	35.20	27.64	21.51	5.69
Total (%)	100.00	100.00	100.00	100.00	100.00
Total participation	246	125	246	93	211
Total by education	805	620	2,250	841	914
	Rural				
Employment sector	No edu (%)	Primary (%)	Sec. edu (%)	Post sec. (%)	Grad. (%)
Participation rate (%)	41.33	33.56	18.89	16.38	24.47
Agriculture	67.40	62.29	55.01	22.56	
Business	22.36	21.89	19.01	15.79	2.17
Official	2.00	5.05	12.05	47.37	92.39
Manufacturing	5.80	8.08	9.29	5.26	
Other	2.45	2.69	4.64	9.02	5.43
Total (%)	100.00	100.00	100.00	100.00	100.00
Total participation	1,552	594	689	133	92
Total by education	3,755	1,770	3,647	812	376

Source: Estimates are based on author’s own calculations using the IHDS-II dataset.

A3.27. Hours of work and regional hourly wages for the IHDS-II women

	Women with dependent children	Hours worked annually (in Rs.[1])	Regional hourly wage (in Rs.[1])
Full sample	Women with young children	1257	18.04
	Women with school-aged children	1333	18.25
Urban	Women with young children	1916	20.30
	Women with school-aged children	1845	19.31
Rural	Women with young children	1078	17.43
	Women with school-aged children	1174	17.92
Nuclear	Women with young children	1164	17.67
	Women with school-aged children	1299	18.21
Extended	Women with young children	1320	18.29
	Women with school-aged children	1392	18.32

Notes: Women who are working in paid jobs outside their households. [1]Rs. is Indian rupees.
Source: Estimated are based on author's own calculation using the IHDS-II dataset.

A3.28. Descriptive statistics: Mothers with young children (age 0–5)

Mother & Household Characteristics	All Mothers	Mother with Twins (1)	Mother without Twins (2)	Mean Difference (1)-(2)	
No. of children	1.49	2.50	1.48	1.02	(0.00)
Regional wage rate	18.82	19.93	18.81	1.12	(0.26)
Land ownership (0/1)	0.45	0.41	0.45	-0.04	(0.51)
Age of mother	25.10	27.57	25.08	2.49	(0.00)
Age at marriage	19.42	20.35	19.41	0.94	(0.11)
Married	0.99	0.98	0.99	-0.01	(0.74)
Widowed & divorced	0.01	0.02	0.01	0.01	(0.74)
No education	0.21	0.17	0.21	-0.04	(0.43)
Primary	0.13	0.11	0.13	-0.02	(0.67)
Secondary	0.42	0.35	0.42	-0.07	(0.30)
Post sec. education	0.14	0.20	0.14	0.06	(0.27)
Graduate education	0.10	0.17	0.10	0.07	(0.20)
OBC	0.33	0.28	0.33	-0.05	(0.43)
Hindu Brahmin	0.05	0.07	0.05	0.03	(0.48)
Hindu Forward	0.16	0.24	0.16	0.08	(0.17)
SC and ST	0.31	0.28	0.31	-0.03	(0.59)
Muslim	0.13	0.09	0.13	-0.04	(0.37)
Christian and others	0.03	0.04	0.03	0.01	(0.67)
Urban	0.32	0.39	0.32	0.07	(0.32)
Childhood in urban	0.19	0.22	0.19	0.03	(0.63)
Market participation rate	0.15	0.06	0.15	-0.09	(0.01)
Observations	6,277	54	6,223	6,277	

Note: Figures in parentheses are p-values.
Source: Estimates are based on author's own calculation using the IHDS-II dataset.

A3.29. Descriptive statistics: Mothers with school-aged children (age 6–17)

Mother & Household Characteristics	All Mothers	Mother with Twins (1)	Mother without Twins (2)	Mean Difference (1)-(2)	
No. of children	2.12	3.13	2.11	1.02	(0.00)
Regional wage rate	18.91	19.06	18.91	0.15	(0.80)
Land ownership (0/1)	0.45	0.38	0.45	-0.07	(0.12)
Age of mother	35.73	36.14	35.73	0.42	(0.40)
Age at marriage	18.04	18.28	18.03	0.25	(0.51)
Married	0.95	0.96	0.95	0.01	(0.76)
Widow & divorced	0.05	0.04	0.05	-0.01	(0.76)
No education	0.34	0.36	0.34	0.01	(0.76)
Primary	0.17	0.13	0.17	-0.04	(0.21)
Secondary	0.34	0.36	0.34	0.01	(0.77)
Post sec. education	0.08	0.09	0.08	0.01	(0.62)
Graduate education	0.07	0.07	0.07	-0.00	(0.96)
OBC	0.36	0.32	0.36	-0.04	(0.36)
Hindu Brahmin	0.06	0.06	0.06	0.00	(0.88)
Hindu Forward	0.19	0.19	0.19	0.01	(0.88)
SC and ST	0.27	0.25	0.27	-0.02	(0.67)
Muslim	0.09	0.13	0.09	0.04	(0.25)
Christian and others	0.03	0.04	0.03	0.01	(0.51)
Urban	0.36	0.34	0.36	-0.02	(0.66)
Childhood in urban	0.18	0.22	0.18	0.04	(0.32)
Market participation rate	0.32	0.36	0.32	0.04	(0.34)
Observations	9,513	118	9,395	9,513	

Note: Figures in parentheses are p-values.
Source: Estimates are based on author's own calculation using the IHDS-II dataset.

A3.30. Descriptive statistics: Urban mothers with young children (age 0–5)

Mother & Household Characteristics	All Mothers	Mother with Twins (1)	Mother without Twins (2)	Mean Difference (1)-(2)	
No. of Children	1.43	2.52	1.41	1.11	(0.00)
Regional wage rate	18.87	20.52	18.85	1.66	(0.33)
Land ownership (0/1)	0.10	0.10	0.10	-0.01	(0.90)
Age of mother	26.11	28.76	26.09	2.68	(0.09)
Age at marriage	20.65	20.95	20.64	0.31	(0.71)
Married	0.99	1.00	0.99	0.01	(0.00)
Widow & Divorced	0.01	0.00	0.01	-0.01	(0.00)
No education	0.11	0.14	0.11	0.03	(0.70)
Primary	0.09	0.05	0.09	-0.04	(0.39)
Secondary	0.41	0.43	0.41	0.02	(0.87)
Post sec. education	0.20	0.10	0.20	-0.10	(0.14)
Graduate education	0.19	0.29	0.19	0.09	(0.37)
OBC	0.31	0.24	0.31	-0.07	(0.47)
Hindu Brahmin	0.06	0.05	0.06	-0.02	(0.75)
Hindu Forward	0.19	0.29	0.19	0.10	(0.35)
SC and ST	0.23	0.24	0.23	0.01	(0.92)
Muslim	0.18	0.14	0.18	-0.03	(0.68)
Christian and others	0.04	0.05	0.04	0.01	(0.80)
Urban	1.00	1.00	1.00	0.00	(.)
Childhood in urban	0.32	0.29	0.32	-0.04	(0.71)
Market participation rate	0.10	0.00	0.10	-0.10	(0.00)
Observations	2,023	21	2,002	2,023	

Note: Figures in parentheses are p-values.
Source: Estimates are based on author's own calculation using the IHDS-II dataset.

A3.31. Descriptive statistics: Urban mothers with school-aged children (age 6–17)

Mother & Household Characteristics	All Mothers	Mother with Twins (1)	Mother without Twins (2)	Mean Difference (1)-(2)	
No. of Children	1.99	3.05	1.97	1.08	(0.00)
Regional wage rate	19.05	19.54	19.05	0.49	(0.62)
Land ownership (0/1)	0.10	0.07	0.11	-0.03	(0.48)
Age of mother	35.86	36.52	35.85	0.68	(0.39)
Age at marriage	19.32	19.60	19.32	0.28	(0.65)
Married	0.95	0.95	0.95	-0.00	(0.92)
Widow & Divorced	0.05	0.05	0.05	0.00	(0.92)
No education	0.17	0.28	0.17	0.11	(0.15)
Primary	0.13	0.05	0.13	-0.08	(0.03)
Secondary	0.42	0.40	0.42	-0.02	(0.83)
Post sec. education	0.13	0.15	0.13	0.02	(0.74)
Graduate education	0.15	0.13	0.15	-0.03	(0.60)
OBC	0.32	0.35	0.32	0.03	(0.73)
Hindu Brahmin	0.08	0.10	0.08	0.02	(0.62)
Hindu Forward	0.23	0.25	0.23	0.02	(0.82)
SC and ST	0.21	0.07	0.21	-0.14	(0.00)
Muslim	0.12	0.20	0.12	0.08	(0.23)
Christian and others	0.03	0.03	0.03	-0.01	(0.71)
Urban	1.00	1.00	1.00	0.00	(.)
Childhood in urban	0.31	0.30	0.31	-0.01	(0.94)
Market participation rate	0.21	0.23	0.21	0.01	(0.86)
Observations	3,407	40	3,367	3,407	

Note: Figures in parentheses are p-values.
Source: Estimates are based on author's own calculation using the IHDS-II dataset.

A3.32. Descriptive statistics: Rural mothers with young children (age 0–5)

Mother & Household Characteristics	All Mothers	Mother with Twins (1)	Mother without Twins (2)	Mean Difference (1)-(2)	
No. of Children	1.52	2.48	1.51	0.98	(0.00)
Regional wage rate	18.79	19.55	18.78	0.77	(0.54)
Land ownership (0/1)	0.62	0.61	0.62	-0.01	(0.89)
Age of mother	24.62	26.82	24.60	2.22	(0.00)
Age at marriage	18.83	19.97	18.83	1.14	(0.15)
Married	0.99	0.97	0.99	-0.02	(0.53)
Widow & Divorced	0.01	0.03	0.01	0.02	(0.53)
No education	0.25	0.18	0.25	-0.07	(0.31)
Primary	0.15	0.15	0.15	0.00	(0.97)
Secondary	0.42	0.30	0.43	-0.12	(0.14)
Post sec. education	0.12	0.27	0.12	0.16	(0.06)
Graduate education	0.06	0.09	0.06	0.03	(0.51)
OBC	0.34	0.30	0.34	-0.03	(0.69)
Hindu Brahmin	0.04	0.09	0.04	0.05	(0.34)
Hindu Forward	0.14	0.21	0.14	0.07	(0.35)
SC and ST	0.35	0.30	0.35	-0.05	(0.56)
Muslim	0.11	0.06	0.11	-0.05	(0.29)
Christian and others	0.02	0.03	0.02	0.01	(0.76)
Urban	0.00	0.00	0.00	0.00	(.)
Childhood in urban	0.13	0.18	0.13	0.05	(0.48)
Market participation rate	0.17	0.09	0.17	-0.08	(0.13)
Observations	4,254	33	4,221	4,254	

Note: Figures in parentheses are p-values.
Source: Estimates are based on author’s own calculation using the IHDS-II dataset.

A3.33. Descriptive statistics: Rural mothers with school-aged children (age 6–17)

Mother & Household Characteristics	All Mothers	Mother with Twins (1)	Mother without Twins (2)	Mean Difference (1)-(2)	
No. of Children	2.19	3.17	2.18	0.99	(0.00)
Regional wage rate	18.84	18.81	18.84	-0.02	(0.98)
Land ownership (0/1)	0.64	0.54	0.64	-0.11	(0.07)
Age of mother	35.67	35.95	35.66	0.29	(0.64)
Age at marriage	17.32	17.60	17.31	0.29	(0.53)
Married	0.95	0.96	0.95	0.01	(0.64)
Widow & Divorced	0.05	0.04	0.05	-0.01	(0.64)
No education	0.44	0.40	0.44	-0.04	(0.45)
Primary	0.19	0.17	0.19	-0.02	(0.65)
Secondary	0.30	0.33	0.30	0.03	(0.55)
Post sec. education	0.05	0.06	0.05	0.01	(0.65)
Graduate education	0.02	0.04	0.02	0.02	(0.45)
OBC	0.38	0.31	0.38	-0.08	(0.16)
Hindu Brahmin	0.04	0.04	0.04	-0.01	(0.78)
Hindu Forward	0.16	0.17	0.16	0.00	(0.96)
SC and ST	0.31	0.35	0.31	0.04	(0.46)
Muslim	0.07	0.09	0.07	0.02	(0.63)
Christian and others	0.03	0.05	0.03	0.02	(0.35)
Urban	0.00	0.00	0.00	0.00	(.)
Childhood in urban	0.11	0.18	0.11	0.07	(0.13)
Market participation rate	0.38	0.44	0.38	0.05	(0.35)
Observations	6,106	78	6,028	6,106	

Note: Figures in parentheses are p-values.
Source: Estimates are based on author's own calculation using the IHDS-II dataset.

A3.34. Descriptive statistics: Mothers in extended family settings with young children (age 0–5)

Mother & Household Characteristics	All Mothers	Mother with Twins (1)	Mother without Twins (2)	Mean Difference (1)-(2)	
No. of Children	1.44	2.44	1.43	1.01	(0.00)
Regional wage rate	18.87	20.26	18.86	1.40	(0.26)
Land ownership (0/1)	0.53	0.44	0.53	-0.09	(0.25)
Age of mother	25.00	27.17	24.98	2.19	(0.00)
Age at marriage	19.65	20.76	19.64	1.12	(0.11)
Married	0.98	0.98	0.98	-0.01	(0.73)
Widow & Divorced	0.02	0.02	0.02	0.01	(0.73)
No education	0.18	0.12	0.18	-0.06	(0.28)
Primary	0.12	0.05	0.12	-0.07	(0.05)
Secondary	0.42	0.39	0.42	-0.03	(0.67)
Post sec. education	0.16	0.22	0.16	0.06	(0.38)
Graduate education	0.12	0.22	0.12	0.10	(0.13)
OBC	0.33	0.29	0.33	-0.04	(0.61)
Hindu Brahmin	0.06	0.05	0.06	-0.01	(0.85)
Hindu Forward	0.18	0.27	0.18	0.09	(0.21)
SC and ST	0.29	0.22	0.29	-0.07	(0.28)
Muslim	0.11	0.12	0.11	0.01	(0.89)
Christian and others	0.03	0.05	0.03	0.02	(0.59)
Urban	0.33	0.44	0.33	0.11	(0.17)
Childhood in urban	0.20	0.27	0.20	0.06	(0.36)
Market participation rate	0.12	0.07	0.12	-0.05	(0.26)
Observations	4,612	41	4,571	4,612	

Note: Figures in parentheses are p-values.
Source: Estimates are based on author's own calculation using the IHDS-II dataset.

A3.35. Descriptive statistics: Mothers in extended family settings with school-aged children (age 6–17)

Mother & Household Characteristics	All Mothers	Mother with Twins (1)	Mother without Twins (2)	Mean Difference (1)-(2)	
No. of Children	2.06	3.08	2.05	1.03	(0.00)
Regional wage rate	18.57	17.78	18.57	-0.79	(0.19)
Land ownership (0/1)	0.53	0.51	0.53	-0.02	(0.82)
Age of mother	35.07	35.72	35.06	0.65	(0.47)
Age at marriage	18.24	18.97	18.23	0.75	(0.27)
Married	0.94	0.92	0.94	-0.02	(0.67)
Widow & Divorced	0.06	0.08	0.06	0.02	(0.67)
No education	0.28	0.31	0.28	0.02	(0.74)
Primary	0.16	0.15	0.16	-0.01	(0.93)
Secondary	0.38	0.38	0.38	0.01	(0.93)
Post sec. education	0.10	0.03	0.10	-0.07	(0.01)
Graduate education	0.08	0.13	0.08	0.05	(0.41)
OBC	0.36	0.23	0.36	-0.13	(0.06)
Hindu Brahmin	0.06	0.13	0.06	0.07	(0.22)
Hindu Forward	0.22	0.21	0.22	-0.02	(0.80)
SC and ST	0.23	0.26	0.23	0.02	(0.76)
Muslim	0.08	0.15	0.08	0.07	(0.23)
Christian and others	0.04	0.03	0.04	-0.01	(0.62)
Urban	0.36	0.33	0.36	-0.02	(0.78)
Childhood in urban	0.18	0.13	0.18	-0.06	(0.31)
Market participation rate	0.27	0.33	0.27	0.06	(0.41)
Observations	4,155	39	4,116	4,155	

Note: Figures in parentheses are p-values.
Source: Estimates are based on author's own calculation using the IHDS-II dataset.

A3.36. Descriptive statistics: Mothers in nuclear family settings with young children (age 0–5)

Mother & Household Characteristics	All Mothers	Mother with Twins (1)	Mother without Twins (2)	Mean Difference (1)-(2)	
No. of Children	1.62	2.69	1.62	1.08	(0.00)
Regional wage rate	18.66	18.88	18.66	0.22	(0.88)
Land ownership (0/1)	0.24	0.31	0.24	0.07	(0.60)
Age of mother	25.37	28.85	25.34	3.50	(0.16)
Age at marriage	18.78	19.08	18.78	0.29	(0.76)
Married	1.00	1.00	1.00	0.00	(0.08)
Widow & Divorced	0.00	0.00	0.00	-0.00	(0.08)
No education	0.29	0.31	0.29	0.02	(0.89)
Primary	0.17	0.31	0.16	0.14	(0.30)
Secondary	0.41	0.23	0.41	-0.18	(0.17)
Post sec. education	0.09	0.15	0.09	0.07	(0.53)
Graduate education	0.05	0.00	0.05	-0.05	(0.00)
OBC	0.32	0.23	0.32	-0.09	(0.48)
Hindu Brahmin	0.03	0.15	0.03	0.12	(0.26)
Hindu Forward	0.11	0.15	0.10	0.05	(0.65)
SC and ST	0.37	0.46	0.37	0.09	(0.52)
Muslim	0.17	0.00	0.17	-0.17	(0.00)
Christian and others	0.01	0.00	0.01	-0.01	(0.00)
Urban	0.30	0.23	0.30	-0.07	(0.58)
Childhood in urban	0.17	0.08	0.17	-0.09	(0.26)
Market participation rate	0.22	0.00	0.22	-0.22	(0.00)
Observations	1,665	13	1,652	1,665	

Note: Figures in parentheses are p-values.
Source: Estimates are based on author’s own calculation using the IHDS-II dataset.

A3.37. Descriptive statistics: Mothers in nuclear family settings with school-aged children (age 6–17)

Mother & Household Characteristics	All Mothers	Mother with Twins (1)	Mother without Twins (2)	Mean Difference (1)-(2)	
No. of Children	2.16	3.15	2.15	1.00	(0.00)
Regional wage rate	19.18	19.69	19.17	0.52	(0.52)
Land ownership (0/1)	0.39	0.32	0.39	-0.07	(0.18)
Age of mother	36.25	36.35	36.25	0.11	(0.85)
Age at marriage	17.88	17.94	17.88	0.06	(0.90)
Married	0.96	0.97	0.96	0.01	(0.42)
Widow & Divorced	0.04	0.03	0.04	-0.01	(0.42)
No education	0.39	0.38	0.39	-0.01	(0.87)
Primary	0.17	0.11	0.17	-0.06	(0.12)
Secondary	0.32	0.34	0.32	0.03	(0.63)
Post sec. education	0.07	0.13	0.07	0.06	(0.11)
Graduate education	0.06	0.04	0.06	-0.02	(0.36)
OBC	0.36	0.37	0.36	0.01	(0.92)
Hindu Brahmin	0.05	0.03	0.05	-0.03	(0.14)
Hindu Forward	0.16	0.19	0.16	0.03	(0.57)
SC and ST	0.30	0.25	0.30	-0.05	(0.35)
Muslim	0.10	0.11	0.10	0.02	(0.67)
Christian and others	0.02	0.05	0.02	0.03	(0.28)
Land ownership (0/1)	0.39	0.32	0.39	-0.07	(0.18)
Urban	0.36	0.34	0.36	-0.02	(0.73)
Childhood in urban	0.18	0.27	0.18	0.09	(0.09)
Market participation rate	0.36	0.38	0.36	0.02	(0.75)
Observations	5,358	79	5,279	5,358	

Note: Figures in parentheses are p-values.
Source: Estimates are based on author's own calculation using the IHDS-II dataset.

A3.38. First stage regression results: Full sample, urban and rural

Dep. variable: Number of children	Young children (0-5)			School-going children (6-17)		
	Twins	First girl	Twins First girl	Twins	First girl	Twins First girl
Full sample						
Twin births	1.01***		1.00***	1.02***		0.98***
	(0.07)		(0.07)	(0.08)		(0.08)
First girl		0.10***	0.10***		0.27***	0.26***
		(0.01)	(0.01)		(0.02)	(0.02)
Observations	6,277	6,277	6,277	9,513	9,513	9,513
F-Statistic	195	51	119	167	239	204
Hansen J statistic (Hour)			0.655			0.156
Chi-sq p-value (Hour)			0.418			0.693
Hansen J statistic (Part.)			0.358			0.062
Chi-sq p-value (Part.)			0.550			0.803
Urban sample						
Twin births	1.12***		1.10***	1.06***		1.01***
	(0.12)		(0.13)	(0.15)		(0.15)
First girl		0.10***	0.09***		0.21***	0.20***
		(0.02)	(0.02)		(0.03)	(0.03)
Observations	2,023	2,023	2,023	3,407	3,407	3,407
F-Statistic	79	17	46	48	64	53
Hansen J statistic (Hour)			0.005			0.329
Chi-sq p-value (Hour)			0.945			0.566
Hansen J statistic (Part.)			0.080			0.196
Chi-sq p-value (Part.)			0.777			0.658
Rural sample						
Twin births	0.94***		0.94***	1.01***		0.98***
	(0.08)		(0.09)	(0.09)		(0.09)
First girl		0.10***	0.10***		0.31***	0.30***
		(0.02)	(0.02)		(0.02)	(0.02)
Observations	4,254	4,254	4,254	6,106	6,106	6,106
F-Statistic	123	34	76	128	177	160
Hansen J statistic (Hour)			0.456			0.136
Chi-sq p-value (Hour)			0.499			0.712
Hansen J statistic (Part.)			0.365			0.111
Chi-sq p-value (Part.)			0.546			0.738

Notes: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Standard errors are reported in parentheses.
Source: Estimates are based on author's own calculation using the IHDS-II dataset.

A3.39. First stage regression results: Full sample, nuclear and extended

Dep. variable: Number of children	Young children (0-5)			School-going children (6-17)		
	Twins	First girl	Twins First girl	Twins	First girl	Twins First girl
Full sample						
Twin births	1.01***		1.00***	1.02***		0.98***
	(0.07)		(0.07)	(0.08)		(0.08)
First girl		0.10***	0.10***		0.27***	0.26***
		(0.01)	(0.01)		(0.02)	(0.02)
Observations	6,277	6,277	6,277	9,513	9,513	9,513
F-Statistic	195	51	119	167	239	204
Hansen J statistic (Hour)			0.655			0.156
Chi-sq p-value (Hour)			0.418			0.693
Hansen J statistic (Part.)			0.358			0.062
Chi-sq p-value (Part.)			0.550			0.803
Nuclear family						
Twin births	1.13***		1.15***	1.02***		0.97***
	(0.14)		(0.14)	(0.10)		(0.10)
First girl		0.06	0.09***		0.28***	0.27***
		(0.09)	(0.03)		(0.02)	(0.02)
Observations	1,665	1,665	1,665	5,358	5,358	5,358
F-Statistic	63	9	36	97	142	118
Chi-sq p-value (Hour)			0.665			0.655
Hansen J statistic (Part.)			0.252			0.174
Chi-sq p-value (Part.)			0.616			0.677
Extended family						
Twin births	0.98***		0.96***	1.04***		1.00***
	(0.09)		(0.09)	(0.11)		(0.11)
First girl		0.11***	0.10***		0.25***	0.25***
		(0.02)	(0.02)		(0.03)	(0.03)
Observations	4,612	4,612	4,612	4,155	4,155	4,155
F-Statistic	130	42	83	86	94	94
Hansen J statistic (Hour)			1.112			0.003
Chi-sq p-value (Hour)			0.292			0.958
Hansen J statistic (Part.)			0.832			0.018
Chi-sq p-value (Part.)			0.362			0.893

Notes: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Standard errors are reported in parentheses.
Source: Estimates are based on author's own calculation using the IHDS-II dataset.

A3.40. Probit & Tobit: Effect of young children on female labour market outcomes

Mother Age 18-54	Probit Part. ME	Tobit Hours ME	IVProbit Twins Part. ME	IVTobit Twins Hours ME	IVProbit FG Part. ME	IVTobit FG Hours ME	IVProbit Twins FG Part. ME	IVTobit Twins FG Hours ME
Main variable:								
No. of children	-0.01*	-18.52*	-0.01	-14.52	-0.01	-18.07	-0.01	-14.16
	(0.01)	(10.06)	(0.06)	(89.78)	(0.08)	(118.99)	(0.04)	(66.08)
Economic variables:								
Log wage rate	0.22***	327.55***	0.22***	327.67***	0.22***	327.84***	0.22***	328.38***
	(0.07)	(103.81)	(0.07)	(104.18)	(0.07)	(105.62)	(0.07)	(104.10)
Land ownership (0/1)	-0.04***	-68.88***	-0.04***	-68.58***	-0.04***	-68.77***	-0.04***	-68.41***
	(0.01)	(14.14)	(0.01)	(14.66)	(0.01)	(14.92)	(0.01)	(14.48)
Demographic variables:								
Age at marriage	-0.01***	-7.42***	-0.01*	-7.38	-0.01	-7.40	-0.01**	-7.33*
	(0.00)	(2.12)	(0.00)	(5.12)	(0.00)	(6.56)	(0.00)	(4.03)
Age of mother	0.01*	21.06*	0.01	19.36	0.01	21.03	0.01	19.66
	(0.01)	(11.43)	(0.02)	(26.22)	(0.02)	(33.80)	(0.01)	(20.60)
Age mother square	-0.00	-0.16	-0.00	-0.13	-0.00	-0.16	-0.00	-0.13
	(0.00)	(0.20)	(0.00)	(0.41)	(0.00)	(0.52)	(0.00)	(0.33)
Married	-0.14***	-192.52***	-0.14***	-194.91***	-0.14***	-192.34***	-0.14***	-193.99***
	(0.03)	(41.23)	(0.04)	(53.09)	(0.04)	(59.25)	(0.04)	(47.35)
Urban	-0.08***	-98.35***	-0.08***	-98.00***	-0.08***	-98.35***	-0.08***	-98.10***
	(0.01)	(17.10)	(0.01)	(18.42)	(0.01)	(18.96)	(0.01)	(18.15)
Childhood in urban	-0.02	-22.77	-0.02	-22.03	-0.02	-22.77	-0.02	-22.21
	(0.01)	(17.56)	(0.01)	(17.60)	(0.01)	(17.61)	(0.01)	(17.61)
Primary	0.00	4.10	0.00	4.45	0.00	4.10	0.00	4.40
	(0.01)	(18.46)	(0.01)	(18.47)	(0.01)	(18.51)	(0.01)	(18.45)
Secondary	-0.08***	-102.25***	-0.08***	-101.76***	-0.08***	-102.09***	-0.08***	-101.44***
	(0.01)	(16.66)	(0.01)	(19.13)	(0.01)	(21.04)	(0.01)	(18.27)
Post sec. education	-0.10***	-111.97***	-0.09***	-110.83***	-0.10***	-111.84***	-0.09***	-110.73***
	(0.02)	(25.36)	(0.02)	(31.32)	(0.02)	(35.75)	(0.02)	(29.15)
Graduate education	0.03	82.82***	0.03	84.57**	0.03	82.98**	0.03	84.63***
	(0.02)	(27.16)	(0.02)	(33.94)	(0.03)	(38.83)	(0.02)	(30.88)
Brahmin	-0.04**	-66.26***	-0.04**	-66.39***	-0.04**	-66.37***	-0.04**	-66.61***
	(0.02)	(25.62)	(0.02)	(25.70)	(0.02)	(25.68)	(0.02)	(25.66)
Forward	-0.04***	-51.36***	-0.04***	-51.38***	-0.04***	-51.30***	-0.04***	-51.22***
	(0.01)	(17.48)	(0.01)	(17.76)	(0.01)	(17.83)	(0.01)	(17.70)
SC and ST	0.07***	88.52***	0.07***	88.03***	0.07***	88.61***	0.07***	88.35***
	(0.01)	(17.21)	(0.01)	(18.04)	(0.01)	(18.63)	(0.01)	(17.75)
Muslim	-0.07***	-81.64***	-0.07***	-82.14***	-0.07***	-81.62***	-0.07***	-81.98***
	(0.01)	(17.06)	(0.01)	(19.19)	(0.01)	(19.87)	(0.01)	(18.42)
Christian and others	-0.03	-31.60	-0.03	-31.70	-0.03	-32.13	-0.03	-33.00
	(0.02)	(37.07)	(0.02)	(37.15)	(0.03)	(37.22)	(0.02)	(36.93)
Observations	6,277	6,277	6,277	6,277	6,277	6,277	6,277	6,277
Uncensored		923		923		923		923
Pseudo-R2	0.097	0.023						

Notes: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Standard errors are reported in parentheses.
Woman specific control variables: age at marriage, age, age square, average regional natural log of wage rate, marital status (married versus divorced and widowed), urban place of residence, childhood place of residence if urban, educational attainments: primary, secondary, post-secondary graduation and no education is base category, caste: Brahmin, Forward Class, SC and ST, Muslim, Christian and others and OBC is considered as base category, land (i.e., wealth) and the regions of India: Northern, North-Eastern, Central, Eastern, Western.
First stage regression in Appendix Table 3.10.
Source: Estimates are based on author's own calculation using the IHDS-II dataset.

A3.41. Probit & Tobit: Effect of school-aged children on female labour market outcomes

Mother Age 22-62	Probit Part. ME	Tobit Hours ME	IVProbit Twins Part. ME	IVTobit Twins Hours ME	IVProbit FG Part. ME	IVTobit FG Hours ME	IVProbit Twins FG Part. ME	IVTobit Twins FG Hours ME
Main variable:								
No. of children	-0.00	-6.18	-0.00	-6.79	-0.01	-8.53	-0.01	-9.10
	(0.00)	(7.82)	(0.04)	(55.78)	(0.03)	(51.98)	(0.02)	(38.38)
Economic variables:								
Log wage rate	0.61***	933.49***	0.61***	931.99***	0.60***	926.68***	0.60***	925.56***
	(0.07)	(111.64)	(0.08)	(132.91)	(0.08)	(130.31)	(0.07)	(122.13)
Land ownership (0/1)	-0.09***	-181.78***	-0.09***	-181.59***	-0.09***	-182.64***	-0.09***	-182.03***
	(0.01)	(16.28)	(0.01)	(16.29)	(0.01)	(16.29)	(0.01)	(16.29)
Demographic variables:								
Age at marriage	-0.00***	-4.69**	-0.00**	-4.70*	-0.00**	-4.78*	-0.00**	-4.77*
	(0.00)	(2.22)	(0.00)	(2.79)	(0.00)	(2.73)	(0.00)	(2.50)
Age of mother	0.02**	34.91***	0.02	34.94*	0.02	34.51*	0.02	34.68**
	(0.01)	(10.70)	(0.01)	(18.99)	(0.01)	(18.21)	(0.01)	(15.22)
Age mother square	-0.00*	-0.39***	-0.00	-0.39	-0.00	-0.39	-0.00	-0.39*
	(0.00)	(0.14)	(0.00)	(0.25)	(0.00)	(0.24)	(0.00)	(0.20)
Married	-0.23***	-413.31***	-0.23***	-413.16***	-0.23***	-411.07***	-0.23***	-411.38***
	(0.02)	(28.36)	(0.02)	(33.84)	(0.02)	(33.68)	(0.02)	(31.25)
Urban	-0.16***	-211.62***	-0.16***	-211.37***	-0.16***	-212.50***	-0.16***	-211.77***
	(0.01)	(19.51)	(0.01)	(19.76)	(0.01)	(19.78)	(0.01)	(19.71)
Childhood in urban	-0.04***	-65.22***	-0.04***	-65.31***	-0.04***	-65.12***	-0.04***	-65.32***
	(0.01)	(21.58)	(0.01)	(21.61)	(0.01)	(21.58)	(0.01)	(21.59)
Primary	-0.07***	-73.98***	-0.07***	-73.92***	-0.07***	-73.88***	-0.07***	-73.80***
	(0.01)	(19.18)	(0.01)	(20.06)	(0.01)	(19.89)	(0.01)	(19.56)
Secondary	-0.18***	-253.53***	-0.18***	-253.62***	-0.18***	-254.19***	-0.18***	-254.19***
	(0.01)	(19.51)	(0.01)	(22.21)	(0.01)	(21.80)	(0.01)	(20.78)
Post sec. education	-0.13***	-120.61***	-0.13***	-120.87***	-0.13***	-121.42***	-0.13***	-121.71***
	(0.02)	(35.93)	(0.02)	(41.37)	(0.02)	(40.73)	(0.02)	(38.56)
Graduate education	0.03	177.10***	0.03	176.85***	0.03	175.63***	0.03	175.53***
	(0.02)	(39.44)	(0.03)	(45.27)	(0.03)	(44.75)	(0.02)	(42.34)
Brahmin	-0.12***	-168.76***	-0.12***	-168.85***	-0.12***	-168.99***	-0.12***	-169.11***
	(0.02)	(31.38)	(0.02)	(31.53)	(0.02)	(31.54)	(0.02)	(31.52)
Forward	-0.10***	-134.26***	-0.10***	-134.38***	-0.10***	-134.54***	-0.10***	-134.71***
	(0.01)	(19.63)	(0.01)	(20.41)	(0.01)	(20.43)	(0.01)	(20.09)
SC and ST	0.13***	204.86***	0.13***	204.89***	0.13***	204.75***	0.13***	204.83***
	(0.01)	(19.13)	(0.01)	(19.99)	(0.01)	(19.74)	(0.01)	(19.46)
Muslim	-0.12***	-169.12***	-0.12***	-169.12***	-0.12***	-168.65***	-0.12***	-168.78***
	(0.02)	(22.22)	(0.02)	(26.46)	(0.02)	(26.15)	(0.02)	(24.47)
Christian and others	-0.12***	-150.10***	-0.12***	-150.44***	-0.12***	-150.95***	-0.12***	-151.38***
	(0.02)	(39.50)	(0.02)	(39.84)	(0.02)	(39.77)	(0.02)	(39.56)
Observations	9,513	9,513	9,513	9,513	9,513	9,513	9,513	9,513
Uncensored		3,064		3,064		3,064		3,064
Pseudo-R2	0.169	0.029						

Notes: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Standard errors are reported in parentheses.
Woman specific control variables: age at marriage, age, age square, average regional natural log of wage rate, marital status (married versus divorced and widowed), urban place of residence, childhood place of residence if urban, educational attainments: primary, secondary, post-secondary graduation and no education is base category, caste: Brahmin, Forward Class, SC and ST, Muslim, Christian and others and OBC is considered as base category, land (*unearned wealth*) and the regions of India: Northern, North-Eastern, Central, Eastern, Western.
First stage regression in Appendix Table 3.10.
Source: Estimates are based on author's own calculation using the IHDS-II dataset.

A3.42. Probit & Tobit: Effect of young children on urban female labour market outcomes

Mother Age 18-54	Probit Part. ME	Tobit Hours ME	IVProbit Twins Part. ME	IVTobit Twins Hours ME	IVProbit FG Part. ME	IVTobit FG Hours ME	IVProbit Twins FG Part. ME	IVTobit Twins FG Hours ME
Main variable:								
No. of children	-0.02**	-46.58**	-0.02	-37.63	-0.02	-44.61	-0.02	-36.03
	(0.01)	(23.01)	(0.02)	(38.72)	(0.11)	(269.82)	(0.06)	(176.75)
Economic variables:								
Log wage rate	0.35***	711.44***	0.34***	692.35***	0.36**	719.71**	0.35**	706.01**
	(0.12)	(246.34)	(0.12)	(250.84)	(0.17)	(352.34)	(0.14)	(294.63)
Land ownership (0/1)	0.00	7.17	0.00	7.75	0.00	8.45	0.00	9.41
	(0.02)	(41.03)	(0.02)	(41.06)	(0.02)	(44.69)	(0.02)	(42.63)
Demographic variables:								
Age at marriage	-0.00	-3.11	-0.00	-3.16	-0.00	-3.00	-0.00	-2.97
	(0.00)	(4.86)	(0.00)	(5.30)	(0.01)	(16.49)	(0.00)	(11.36)
Age of mother	0.01	19.93	0.00	12.12	0.01	19.57	0.01	13.47
	(0.01)	(21.25)	(0.01)	(22.66)	(0.03)	(62.21)	(0.02)	(42.82)
Age mother square	-0.00	-0.14	0.00	0.00	-0.00	-0.13	0.00	-0.02
	(0.00)	(0.34)	(0.00)	(0.36)	(0.00)	(0.90)	(0.00)	(0.63)
Married	-0.14***	-265.80***	-0.14***	-266.33***	-0.14***	-264.15***	-0.14***	-264.02***
	(0.04)	(67.92)	(0.04)	(69.28)	(0.04)	(90.53)	(0.04)	(80.19)
Childhood in urban	-0.02	-34.07	-0.02	-33.35	-0.02	-34.55	-0.02	-34.03
	(0.01)	(28.53)	(0.01)	(28.73)	(0.01)	(31.04)	(0.01)	(29.66)
Primary	-0.02	-54.59	-0.03	-56.54	-0.02	-54.51	-0.03	-56.06
	(0.03)	(54.36)	(0.03)	(54.42)	(0.03)	(54.67)	(0.03)	(54.58)
Secondary	-0.07***	-153.84***	-0.07***	-153.67***	-0.07**	-152.49***	-0.07***	-151.69***
	(0.02)	(44.23)	(0.02)	(45.85)	(0.03)	(57.97)	(0.03)	(51.18)
Post sec. education	-0.09***	-170.56***	-0.09***	-171.26***	-0.09**	-170.84**	-0.09***	-171.42***
	(0.03)	(52.18)	(0.03)	(57.05)	(0.04)	(79.87)	(0.03)	(65.56)
Graduate education	0.00	24.57	0.01	26.65	0.01	26.10	0.01	28.38
	(0.02)	(48.97)	(0.02)	(49.42)	(0.03)	(73.81)	(0.03)	(61.04)
Brahmin	-0.04	-83.60*	-0.04	-83.57*	-0.04	-84.75	-0.04	-85.09*
	(0.03)	(50.55)	(0.03)	(50.65)	(0.03)	(52.14)	(0.03)	(50.88)
Forward	-0.02	-39.91	-0.02	-37.88	-0.02	-39.66	-0.02	-37.81
	(0.02)	(41.28)	(0.02)	(41.58)	(0.02)	(42.12)	(0.02)	(41.95)
SC and ST	-0.02	-31.24	-0.02	-30.58	-0.01	-30.17	-0.01	-29.30
	(0.02)	(39.41)	(0.02)	(39.42)	(0.02)	(40.31)	(0.02)	(39.86)
Muslim	-0.05***	-92.12**	-0.05***	-91.45**	-0.05***	-92.48**	-0.05***	-91.95**
	(0.02)	(36.63)	(0.02)	(37.22)	(0.02)	(40.33)	(0.02)	(39.33)
Christian and others	0.01	21.19	0.01	19.38	0.01	18.82	0.01	17.17
	(0.04)	(73.92)	(0.04)	(73.73)	(0.04)	(74.49)	(0.04)	(73.93)
Observations	2,023	2,023	2,023	2,023	2,023	2,023	2,023	2,023
Uncensored		198		198		198		198
Pseudo-R2	0.087	0.024						

Notes: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Standard errors are reported in parentheses.
Woman specific control variables: age at marriage, age, age square, average regional natural log of wage rate, marital status (married versus divorced and widowed), urban place of residence, childhood place of residence if urban, educational attainments: primary, secondary, post-secondary graduation and no education is base category, caste: Brahmin, Forward Class, SC and ST, Muslim, Christian and others and OBC is considered as base category, land (i.e., wealth) and the regions of India: Northern, North-Eastern, Central, Eastern, Western.
First stage regression in Appendix Table 3.10.
Source: Estimates are based on author's own calculation using the IHDS-II dataset.

A3.43. Probit & Tobit: Effect of school-aged on urban female labour market outcomes

Mother Age 22-56	Probit Part. ME	Tobit Hours ME	IVProbit Twins Part. ME	IVTobit Twins Hours ME	IVProbit FG Part. ME	IVTobit FG Hours ME	IVProbit Twins FG Part. ME	IVTobit Twins FG Hours ME
Main variable:								
No. of children	-0.00	-5.68	-0.00	-5.92	-0.00	-8.75	-0.00	-8.82
	(0.01)	(16.63)	(0.05)	(98.02)	(0.06)	(126.53)	(0.04)	(76.98)
Economic variables:								
Log wage rate	0.64***	1364.35***	0.64***	1364.19***	0.64***	1358.48***	0.64***	1360.28***
	(0.10)	(213.46)	(0.11)	(226.98)	(0.11)	(234.97)	(0.11)	(222.89)
Land ownership (0/1)	-0.04*	-92.79**	-0.04*	-92.65**	-0.04*	-93.36**	-0.04*	-92.15**
	(0.02)	(46.52)	(0.02)	(46.83)	(0.02)	(46.80)	(0.02)	(46.61)
Demographic variables:								
Age at marriage	-0.00	-5.77	-0.00	-5.79	-0.00	-6.15	-0.00	-6.08
	(0.00)	(4.49)	(0.00)	(6.14)	(0.00)	(7.09)	(0.00)	(5.58)
Age of mother	0.04***	83.59***	0.04*	83.62**	0.04*	83.56*	0.04**	83.77**
	(0.01)	(27.57)	(0.02)	(41.13)	(0.02)	(48.47)	(0.02)	(36.63)
Age mother square	-0.00***	-0.96***	-0.00*	-0.96*	-0.00	-0.96	-0.00*	-0.96**
	(0.00)	(0.37)	(0.00)	(0.54)	(0.00)	(0.64)	(0.00)	(0.48)
Married	-0.26***	-520.08***	-0.26***	-520.00***	-0.25***	-516.11***	-0.26***	-517.62***
	(0.03)	(49.05)	(0.03)	(60.05)	(0.03)	(66.44)	(0.03)	(57.10)
Childhood in urban	-0.03**	-57.08*	-0.03**	-57.09*	-0.03**	-57.75*	-0.03**	-57.44*
	(0.01)	(31.18)	(0.01)	(31.27)	(0.01)	(31.38)	(0.01)	(31.29)
Primary	-0.10***	-185.57***	-0.10***	-185.39***	-0.10***	-184.22***	-0.10***	-183.68***
	(0.02)	(42.92)	(0.02)	(45.65)	(0.02)	(47.52)	(0.02)	(44.88)
Secondary	-0.19***	-345.47***	-0.19***	-345.36***	-0.19***	-346.67***	-0.19***	-345.31***
	(0.02)	(37.09)	(0.02)	(42.89)	(0.02)	(45.27)	(0.02)	(41.13)
Post sec. education	-0.15***	-245.35***	-0.15***	-245.30***	-0.15***	-245.32***	-0.15***	-245.04***
	(0.02)	(50.44)	(0.03)	(60.81)	(0.03)	(67.93)	(0.03)	(57.79)
Graduate education	-0.03	12.06	-0.03	12.17	-0.03	9.87	-0.03	11.76
	(0.03)	(50.14)	(0.03)	(59.93)	(0.03)	(66.47)	(0.03)	(56.51)
Brahmin	-0.07**	-117.42**	-0.07**	-117.40**	-0.07**	-119.36**	-0.07**	-118.25**
	(0.03)	(52.61)	(0.03)	(53.66)	(0.03)	(54.89)	(0.03)	(53.60)
Forward	-0.06***	-99.89***	-0.06***	-99.82***	-0.06***	-100.91**	-0.06***	-99.95***
	(0.02)	(36.71)	(0.02)	(38.68)	(0.02)	(40.89)	(0.02)	(38.51)
SC and ST	0.07***	165.27***	0.07***	165.44***	0.07***	163.39***	0.07***	165.55***
	(0.02)	(42.38)	(0.02)	(43.67)	(0.02)	(43.71)	(0.02)	(42.94)
Muslim	-0.10***	-170.15***	-0.10***	-170.07***	-0.10***	-170.82***	-0.10***	-169.92***
	(0.02)	(37.02)	(0.03)	(46.88)	(0.03)	(51.31)	(0.02)	(43.39)
Christian and others	0.00	13.93	0.00	13.95	0.00	12.31	0.00	13.30
	(0.04)	(79.42)	(0.04)	(79.48)	(0.04)	(79.63)	(0.04)	(79.40)
Observations	3,407	3,407	3,407	3,407	3,407	3,407	3,407	3,407
Uncensored		727		727		727		727
Pseudo-R2	0.132	0.029						

Notes: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Standard errors are reported in parentheses.
Woman specific control variables: age of marriage, age, age square, average regional natural log of wage rate, marital status (married versus divorced and widowed), urban place of residence, childhood place of residence if urban, educational attainments: primary, secondary, post-secondary graduation and no education is base category, caste: Brahmin, Forward Class, SC and ST, Muslim, Christian and others and OBC is considered as base category, land (i.e., wealth) and the regions of India: Northern, North-Eastern, Central, Eastern, Western.
First stage regression in Appendix Table 3.10.
Source: Estimates are based on author's own calculation using the IHDS-II dataset.

A3.44. Probit & Tobit: Effect of young children on rural female labour market outcomes

Mother Age 18-54	Probit Part. ME	Tobit Hours ME	IVProbit Twins Part. ME	IVTobit Twins Hours ME	IVProbit FG Part. ME	IVTobit FG Hours ME	IVProbit Twins FG Part. ME	IVTobit Twins FG Hours ME
Main variable:								
No. of children	-0.01	-12.57	-0.01	-10.26	-0.01	-12.38	-0.01	-10.14
	(0.01)	(11.06)	(0.08)	(96.29)	(0.10)	(129.58)	(0.06)	(73.16)
Economic variables:								
Log wage rate	0.17*	232.97**	0.18*	236.36**	0.17*	232.82**	0.17*	234.85**
	(0.09)	(114.20)	(0.09)	(115.58)	(0.09)	(116.14)	(0.09)	(114.90)
Land ownership (0/1)	-0.05***	-74.96***	-0.05***	-74.81***	-0.05***	-74.93***	-0.05***	-74.74***
	(0.01)	(14.46)	(0.01)	(14.84)	(0.01)	(15.00)	(0.01)	(14.72)
Demographic variables:								
Age at marriage	-0.01***	-9.44***	-0.01**	-9.39*	-0.01	-9.43	-0.01**	-9.36**
	(0.00)	(2.35)	(0.00)	(5.36)	(0.01)	(6.85)	(0.00)	(4.31)
Age of mother	0.02*	26.35*	0.02	26.16	0.02	26.34	0.02	26.16
	(0.01)	(14.92)	(0.03)	(32.36)	(0.03)	(41.82)	(0.02)	(26.43)
Age mother square	-0.00	-0.26	-0.00	-0.26	-0.00	-0.26	-0.00	-0.26
	(0.00)	(0.27)	(0.00)	(0.52)	(0.00)	(0.66)	(0.00)	(0.43)
Married	-0.13***	-157.59***	-0.13**	-160.24**	-0.13**	-157.54**	-0.13***	-159.34***
	(0.04)	(47.49)	(0.05)	(63.84)	(0.06)	(73.62)	(0.05)	(56.76)
Childhood in urban	-0.02	-22.16	-0.02	-21.40	-0.02	-22.13	-0.02	-21.52
	(0.02)	(21.49)	(0.02)	(21.66)	(0.02)	(21.79)	(0.02)	(21.57)
Primary	0.01	15.29	0.01	15.63	0.01	15.29	0.01	15.53
	(0.02)	(19.18)	(0.02)	(19.20)	(0.02)	(19.23)	(0.02)	(19.17)
Secondary	-0.08***	-84.63***	-0.08***	-84.33***	-0.08***	-84.58***	-0.08***	-84.22***
	(0.01)	(17.48)	(0.02)	(20.24)	(0.02)	(22.44)	(0.02)	(19.38)
Post sec. education	-0.09***	-83.85***	-0.09***	-82.56**	-0.09***	-83.74**	-0.09***	-82.46**
	(0.02)	(29.43)	(0.03)	(35.51)	(0.03)	(42.24)	(0.03)	(34.08)
Graduate education	-0.01	61.33*	-0.00	62.45	-0.01	61.33	-0.00	62.15
	(0.03)	(36.46)	(0.03)	(42.44)	(0.04)	(47.81)	(0.03)	(39.73)
Brahmin	-0.05*	-55.90*	-0.05*	-55.73*	-0.05*	-55.89*	-0.05*	-55.72*
	(0.03)	(29.88)	(0.03)	(29.95)	(0.03)	(29.89)	(0.03)	(29.97)
Forward	-0.05***	-62.85***	-0.05***	-62.86***	-0.05***	-62.83***	-0.05***	-62.76***
	(0.02)	(17.46)	(0.02)	(17.72)	(0.02)	(17.71)	(0.02)	(17.62)
SC and ST	0.10***	115.32***	0.10***	114.88***	0.10***	115.33***	0.10***	115.03***
	(0.01)	(18.25)	(0.01)	(19.48)	(0.02)	(20.14)	(0.01)	(18.98)
Muslim	-0.07***	-75.92***	-0.07***	-76.43***	-0.07***	-75.88***	-0.07***	-76.17***
	(0.02)	(18.81)	(0.02)	(21.45)	(0.02)	(21.90)	(0.02)	(20.30)
Christian and others	-0.06**	-67.02*	-0.06**	-66.80*	-0.06**	-67.24*	-0.07**	-67.71*
	(0.03)	(38.86)	(0.03)	(39.10)	(0.03)	(39.09)	(0.03)	(38.82)
Observations	4,254	4,254	4,254	4,254	4,254	4,254	4,254	4,254
Uncensored		725		725		725		725
Pseudo-R2	0.111	0.027						

Notes: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$. Standard errors are reported in parentheses.
Woman specific control variables: age of marriage, age, age square, average regional natural log of wage rate, marital status (married versus divorced and widowed), urban place of residence, childhood place of residence if urban, educational attainments: primary, secondary, post-secondary graduation and no education is base category, caste: Brahmin, Forward Class, SC and ST, Muslim, Christian and others and OBC is considered as base category, land (i.e., wealth) and the regions of India: Northern, North-Eastern, Central, Eastern, Western.
Refer to Appendix Table 3.10 for the first stage regression results.
Source: Estimates are based on author's own calculation using the IHDS-II dataset.

A3.45. Probit & Tobit: Effect of school-aged on rural female labour market outcomes

Mother Age 22-62	Probit Part. ME	Tobit Hours ME	IVProbit Twins Part. ME	IVTobit Twins Hours ME	IVProbit FG Part. ME	IVTobit FG Hours ME	IVProbit Twins FG Part. ME	IVTobit Twins FG Hours ME
Main variable:								
No. of children	-0.01	-7.72	-0.01	-8.24	-0.01	-9.72	-0.01	-10.25
	(0.01)	(8.78)	(0.05)	(69.27)	(0.04)	(53.09)	(0.03)	(42.28)
Economic variables:								
Log wage rate	0.61***	743.11***	0.61***	741.48***	0.60***	736.36***	0.60***	734.84***
	(0.09)	(132.57)	(0.12)	(177.69)	(0.11)	(160.92)	(0.10)	(151.63)
Land ownership (0/1)	-0.10***	-208.06***	-0.10***	-207.92***	-0.10***	-208.75***	-0.10***	-208.36***
	(0.01)	(17.56)	(0.01)	(17.62)	(0.01)	(17.57)	(0.01)	(17.58)
Demographic variables:								
Age at marriage	-0.00**	-6.14**	-0.00**	-6.13**	-0.00**	-6.15**	-0.00**	-6.14**
	(0.00)	(2.52)	(0.00)	(3.04)	(0.00)	(2.81)	(0.00)	(2.69)
Age of mother	0.01	24.13**	0.01	24.14	0.01	23.71	0.01	23.83
	(0.01)	(11.75)	(0.02)	(21.74)	(0.01)	(18.31)	(0.01)	(16.15)
Age mother square	-0.00	-0.27*	-0.00	-0.27	-0.00	-0.27	-0.00	-0.27
	(0.00)	(0.15)	(0.00)	(0.29)	(0.00)	(0.24)	(0.00)	(0.21)
Married	-0.21***	-345.06***	-0.21***	-344.96***	-0.21***	-343.42***	-0.21***	-343.57***
	(0.03)	(32.44)	(0.03)	(40.13)	(0.03)	(37.54)	(0.03)	(35.57)
Childhood in urban	-0.05***	-73.48***	-0.05***	-73.62**	-0.05***	-72.81**	-0.05***	-73.21**
	(0.02)	(28.46)	(0.02)	(28.69)	(0.02)	(28.56)	(0.02)	(28.49)
Primary	-0.06***	-45.47**	-0.06***	-45.53**	-0.06***	-45.68**	-0.06***	-45.75**
	(0.02)	(21.55)	(0.02)	(22.84)	(0.02)	(22.19)	(0.02)	(21.98)
Secondary	-0.17***	-218.27***	-0.17***	-218.47***	-0.17***	-218.73***	-0.17***	-218.99***
	(0.01)	(22.68)	(0.02)	(26.67)	(0.02)	(25.17)	(0.02)	(24.27)
Post sec. education	-0.12***	-40.86	-0.12***	-41.23	-0.12***	-42.36	-0.12***	-42.71
	(0.03)	(52.07)	(0.04)	(59.78)	(0.03)	(55.86)	(0.03)	(54.62)
Graduate education	0.02	275.81***	0.02	275.28***	0.02	276.64***	0.02	275.51***
	(0.04)	(76.05)	(0.05)	(82.88)	(0.05)	(80.20)	(0.04)	(78.67)
Brahmin	-0.17***	-190.68***	-0.17***	-190.75***	-0.17***	-190.29***	-0.17***	-190.48***
	(0.03)	(39.46)	(0.03)	(39.72)	(0.03)	(39.58)	(0.03)	(39.60)
Forward	-0.13***	-157.44***	-0.13***	-157.64***	-0.13***	-157.44***	-0.13***	-157.79***
	(0.02)	(22.67)	(0.02)	(23.36)	(0.02)	(23.07)	(0.02)	(22.96)
SC and ST	0.16***	219.43***	0.16***	219.31***	0.16***	219.72***	0.16***	219.45***
	(0.01)	(20.89)	(0.02)	(21.98)	(0.02)	(21.52)	(0.02)	(21.27)
Muslim	-0.14***	-162.12***	-0.14***	-162.22***	-0.14***	-161.37***	-0.14***	-161.70***
	(0.02)	(27.73)	(0.02)	(31.19)	(0.02)	(30.14)	(0.02)	(29.17)
Christian and others	-0.21***	-236.75***	-0.21***	-237.17***	-0.21***	-237.47***	-0.21***	-238.08***
	(0.03)	(41.93)	(0.03)	(42.76)	(0.03)	(42.44)	(0.03)	(42.17)
Observations	6,106	6,106	6,106	6,106	6,106	6,106	6,106	6,106
Uncensored		2,337		2,337		2,337		2,337
Pseudo-R2	0.169	0.031						

Notes: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Standard errors are reported in parentheses.
Woman specific control variables: age at marriage, age, age square, average regional natural log of wage rate, marital status (married versus divorced and widowed), urban place of residence, childhood place of residence if urban, educational attainments: primary, secondary, post-secondary graduation and no education is base category, caste: Brahmin, Forward Class, SC and ST, Muslim, Christian and others and OBC is considered as base category, land (i.e., wealth) and the regions of India: Northern, North-Eastern, Central, Eastern, Western.
Refer to Appendix Table 3.10 for the first stage regression results.
Source: Estimates are based on author's own calculation using the IHDS-II dataset.

A3.46. Probit & Tobit: Effect of young children on female labour market outcomes in the nuclear family setting

Mother Age 18-54 At Least One Child	Probit Part. ME	Tobit Hours ME	IVProbit Twins Part. ME	IVTobit Twins Hours ME	IVProbit FG Part. ME	IVTobit FG Hours ME	IVProbit Twins FG Part. ME	IVTobit Twins FG Hours ME
Main variable:								
No. of children	-0.04***	-56.98***	-0.04	-50.08	-0.04	-57.81	-0.04	-47.69
	(0.02)	(21.08)	(0.02)	(31.00)	(0.15)	(819.15)	(0.08)	(200.57)
Economic variables:								
Log wage rate	-0.05	-50.57	-0.05	-54.55	-0.05	-322.87	-0.05	-51.26
	(0.18)	(237.98)	(0.18)	(237.38)	(0.18)	(336.36)	(0.18)	(246.12)
Land ownership (0/1)	-0.00	-12.46	-0.01	-13.67	-0.00	-12.03	-0.01	-13.07
	(0.02)	(31.47)	(0.02)	(31.47)	(0.02)	(37.38)	(0.02)	(31.80)
Demographic variables:								
Age at marriage	-0.01***	-10.95**	-0.01***	-10.94**	-0.01	-11.17	-0.01**	-10.64
	(0.00)	(4.64)	(0.00)	(4.90)	(0.01)	(37.96)	(0.00)	(10.38)
Age of mother	0.01	12.50	0.00	5.97	0.01	4.29	0.00	7.05
	(0.02)	(21.40)	(0.02)	(23.80)	(0.04)	(177.78)	(0.03)	(54.43)
Age mother square	0.00	-0.05	0.00	0.07	0.00	0.09	0.00	0.05
	(0.00)	(0.37)	(0.00)	(0.42)	(0.00)	(2.67)	(0.00)	(0.86)
Married	-0.44**	-703.14***	-0.44**	-703.16***	-0.44*	-756.94***	-0.44**	-697.31***
	(0.20)	(220.41)	(0.20)	(221.05)	(0.23)	(265.65)	(0.20)	(230.53)
Urban	-0.16***	-205.81***	-0.16***	-204.54***	-0.17***	-204.30***	-0.16***	-206.61***
	(0.03)	(38.98)	(0.03)	(41.14)	(0.03)	(53.51)	(0.03)	(41.20)
Childhood in urban	-0.02	-18.36	-0.02	-18.98	-0.02	-19.55	-0.02	-18.49
	(0.03)	(40.67)	(0.03)	(40.59)	(0.03)	(60.63)	(0.03)	(41.73)
Primary	0.01	15.07	0.01	16.51	0.01	15.08	0.01	15.85
	(0.03)	(36.94)	(0.03)	(36.99)	(0.03)	(75.63)	(0.03)	(40.07)
Secondary	-0.08***	-97.00***	-0.08***	-96.30***	-0.08***	-100.02	-0.08***	-96.41**
	(0.03)	(35.83)	(0.03)	(36.54)	(0.03)	(93.55)	(0.03)	(40.74)
Post sec. education	-0.05	-43.99	-0.05	-40.42	-0.05	-50.88	-0.04	-36.23
	(0.04)	(60.98)	(0.04)	(61.57)	(0.05)	(145.13)	(0.04)	(68.50)
Graduate education	0.11**	240.67***	0.11**	235.64***	0.11*	243.34**	0.11**	240.90***
	(0.05)	(83.66)	(0.05)	(83.75)	(0.06)	(104.32)	(0.06)	(85.41)
Brahmin	-0.04	-56.14	-0.03	-49.95	-0.04	-57.12	-0.03	-51.92
	(0.06)	(75.21)	(0.06)	(77.19)	(0.06)	(76.67)	(0.06)	(75.86)
Forward	-0.14***	-165.31***	-0.13***	-164.43***	-0.14***	-172.19***	-0.13***	-164.31***
	(0.03)	(33.63)	(0.03)	(34.80)	(0.03)	(54.89)	(0.03)	(35.07)
SC and ST	0.06**	95.23***	0.06**	94.19***	0.06**	91.66**	0.06**	96.19***
	(0.03)	(35.84)	(0.03)	(36.01)	(0.03)	(42.65)	(0.03)	(36.39)
Muslim	-0.12***	-137.07***	-0.12***	-138.93***	-0.12***	-141.50***	-0.12***	-139.34***
	(0.03)	(34.86)	(0.03)	(35.45)	(0.03)	(51.64)	(0.03)	(37.46)
Christian and others	-0.10	-97.70	-0.10	-100.91	-0.10	-94.45	-0.11	-110.43
	(0.07)	(108.95)	(0.07)	(107.47)	(0.08)	(194.27)	(0.07)	(106.12)
Observations	1,665	1,665	1,665	1,665	1,665	1,665	1,665	1,665
Uncensored		370		370		370		370
Pseudo-R2	0.112	0.024						

Notes: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Standard errors are reported in parentheses.
Woman specific control variables: age at marriage, age, age square, average regional natural log of wage rate, marital status (married versus divorced and widowed), urban place of residence, childhood place of residence if urban, educational attainments: primary, secondary, post-secondary graduation and no education is base category, caste: Brahmin, Forward Class, SC and ST, Muslim, Christian and others and OBC is considered as base category, land (i.e., wealth) and the regions of India: Northern, North-Eastern, Central, Eastern, Western.
Refer to Appendix Table 3.10 for the first stage regression results.
Source: Estimates are based on author's own calculation using the IHDS-II dataset.

A3.47. Probit & Tobit: Effect of school-aged on female labour market outcomes in the nuclear family setting

Mother Age 22-62	Probit Part. ME	Tobit Hours ME	IVProbit Twins Part. ME	IVTobit Twins Hours ME	IVProbit FG Part. ME	IVTobit FG Hours ME	IVProbit Twins FG Part. ME	IVTobit Twins FG Hours ME
Main variable:								
No. of children	-0.01	-12.22	-0.01	-12.78	-0.01	-14.91	-0.01	-15.42
	(0.01)	(10.68)	(0.05)	(70.24)	(0.04)	(67.51)	(0.03)	(49.37)
Economic variables:								
Log wage rate	0.64***	1002.84***	0.63***	1001.53***	0.63***	997.30***	0.63***	995.90***
	(0.09)	(152.80)	(0.11)	(180.35)	(0.11)	(177.43)	(0.10)	(166.50)
Land ownership (0/1)	-0.07***	-157.16***	-0.07***	-157.02***	-0.07***	-158.23***	-0.07***	-157.55***
	(0.01)	(21.48)	(0.01)	(21.50)	(0.01)	(21.50)	(0.01)	(21.49)
Demographic variables:								
Age at marriage	-0.00*	-4.54	-0.00	-4.53	-0.00*	-4.68	-0.00*	-4.61
	(0.00)	(2.93)	(0.00)	(3.18)	(0.00)	(3.19)	(0.00)	(3.07)
Age of mother	0.01	26.53*	0.01	26.53	0.01	26.09	0.01	26.24
	(0.01)	(14.61)	(0.01)	(22.74)	(0.01)	(22.45)	(0.01)	(19.15)
Age mother square	-0.00	-0.29	-0.00	-0.29	-0.00	-0.28	-0.00	-0.29
	(0.00)	(0.19)	(0.00)	(0.31)	(0.00)	(0.30)	(0.00)	(0.25)
Married	-0.33***	-535.87***	-0.33***	-535.86***	-0.33***	-534.52***	-0.33***	-534.92***
	(0.03)	(38.92)	(0.03)	(42.90)	(0.03)	(42.89)	(0.03)	(40.96)
Urban	-0.18***	-240.92***	-0.18***	-240.68***	-0.19***	-241.93***	-0.18***	-241.04***
	(0.01)	(26.46)	(0.01)	(26.71)	(0.02)	(26.73)	(0.01)	(26.65)
Childhood in urban	-0.06***	-101.64***	-0.06***	-101.88***	-0.06***	-101.13***	-0.06***	-101.85***
	(0.02)	(29.73)	(0.02)	(29.76)	(0.02)	(29.76)	(0.02)	(29.75)
Primary	-0.06***	-56.90**	-0.06***	-56.88**	-0.06***	-56.81**	-0.06***	-56.80**
	(0.02)	(25.56)	(0.02)	(27.40)	(0.02)	(27.15)	(0.02)	(26.44)
Secondary	-0.17***	-225.66***	-0.17***	-225.82***	-0.17***	-226.47***	-0.17***	-226.59***
	(0.02)	(27.10)	(0.02)	(30.10)	(0.02)	(29.91)	(0.02)	(28.54)
Post sec. education	-0.15***	-157.93***	-0.15***	-158.43***	-0.15***	-158.85***	-0.15***	-159.76***
	(0.03)	(53.55)	(0.03)	(59.26)	(0.03)	(59.75)	(0.03)	(56.81)
Graduate education	0.06*	229.97***	0.06	229.80***	0.06	228.35***	0.06*	228.43***
	(0.03)	(58.02)	(0.04)	(65.02)	(0.04)	(64.64)	(0.03)	(61.56)
Brahmin	-0.12***	-146.31***	-0.12***	-146.22***	-0.12***	-146.72***	-0.12***	-146.37***
	(0.03)	(48.04)	(0.03)	(48.19)	(0.03)	(48.14)	(0.03)	(48.17)
Forward	-0.11***	-151.47***	-0.11***	-151.60***	-0.11***	-152.05***	-0.11***	-152.18***
	(0.02)	(27.12)	(0.02)	(27.81)	(0.02)	(27.85)	(0.02)	(27.51)
SC and ST	0.13***	210.21***	0.13***	210.33***	0.13***	210.43***	0.13***	210.64***
	(0.02)	(24.88)	(0.02)	(25.73)	(0.02)	(25.46)	(0.02)	(25.20)
Muslim	-0.15***	-197.23***	-0.14***	-197.11***	-0.14***	-196.85***	-0.14***	-196.67***
	(0.02)	(29.15)	(0.02)	(34.14)	(0.02)	(34.11)	(0.02)	(31.90)
Christian and others	-0.12***	-144.40**	-0.12***	-144.92**	-0.12***	-145.65**	-0.12***	-146.51**
	(0.04)	(61.90)	(0.04)	(62.29)	(0.04)	(62.15)	(0.04)	(61.77)
Observations	5,358	5,358	5,358	5,358	5,358	5,358	5,358	5,358
Uncensored		1,941		1,941		1,941		1,941
Pseudo-R2	0.180	0.029						

Notes: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Standard errors are reported in parentheses.
Woman specific control variables: age at marriage, age, age square, average regional natural log of wage rate, marital status (married versus divorced and widowed), urban place of residence, childhood place of residence if urban, educational attainments: primary, secondary, post-secondary graduation and no education is base category, caste: Brahmin, Forward Class, SC and ST, Muslim, Christian and others and OBC is considered as base category, land (i.e., wealth) and the regions of India: Northern, North-Eastern, Central, Eastern, Western.
Refer to Appendix Table 3.10 for the first stage regression results.
Source: Estimates are based on author's own calculation using the IHDS-II dataset.

A3.48. Probit & Tobit: Effect of young children on female labour market outcomes in the extended family setting

Mother Age 18-47	Probit Part. ME	Tobit Hours ME	IVProbit Twins Part. ME	IVTobit Twins Hours ME	IVProbit FG Part. ME	IVTobit FG Hours ME	IVProbit Twins FG Part. ME	IVTobit Twins FG Hours ME
Main variable:								
No. of children	-0.00	-9.13	-0.00	-6.13	-0.00	-9.33	-0.00	-6.49
	(0.01)	(11.55)	(0.06)	(85.82)	(0.09)	(129.67)	(0.05)	(65.42)
Economic variables:								
Log wage rate	0.27***	406.66***	0.27***	408.00***	0.27***	406.51***	0.27***	408.02***
	(0.07)	(111.24)	(0.07)	(111.98)	(0.07)	(112.57)	(0.07)	(112.09)
Land ownership (0/1)	-0.01	-27.52*	-0.01	-27.38*	-0.01	-27.56*	-0.01	-27.29*
	(0.01)	(16.58)	(0.01)	(16.56)	(0.01)	(16.59)	(0.01)	(16.58)
Demographic variables:								
Age at marriage	-0.00*	-4.16*	-0.00	-4.12	-0.00	-4.17	-0.00	-4.12
	(0.00)	(2.39)	(0.00)	(5.15)	(0.00)	(7.29)	(0.00)	(4.17)
Age of mother	0.01	19.95	0.01	19.71	0.01	19.97	0.01	19.74
	(0.01)	(14.03)	(0.02)	(27.18)	(0.03)	(38.26)	(0.02)	(22.56)
Age mother square	-0.00	-0.16	-0.00	-0.16	-0.00	-0.16	-0.00	-0.16
	(0.00)	(0.25)	(0.00)	(0.43)	(0.00)	(0.59)	(0.00)	(0.36)
Married	-0.13***	-174.61***	-0.13***	-176.11***	-0.13***	-174.67***	-0.13***	-175.42***
	(0.03)	(36.10)	(0.03)	(47.83)	(0.04)	(57.23)	(0.03)	(42.99)
Urban	-0.04***	-38.73**	-0.04***	-38.62*	-0.04***	-38.76*	-0.04***	-38.57**
	(0.01)	(19.14)	(0.01)	(19.71)	(0.01)	(19.94)	(0.01)	(19.58)
Childhood in urban	-0.02	-20.48	-0.02	-19.66	-0.02	-20.49	-0.02	-19.94
	(0.01)	(18.85)	(0.01)	(18.97)	(0.01)	(19.05)	(0.01)	(18.93)
Primary	-0.00	-2.36	-0.00	-2.14	-0.00	-2.38	-0.00	-2.14
	(0.02)	(21.66)	(0.02)	(21.76)	(0.02)	(21.87)	(0.02)	(21.73)
Secondary	-0.07***	-104.08***	-0.07***	-103.66***	-0.08***	-104.18***	-0.07***	-103.48***
	(0.01)	(18.77)	(0.01)	(20.99)	(0.01)	(23.72)	(0.01)	(20.47)
Post sec. education	-0.10***	-124.31***	-0.10***	-123.51***	-0.10***	-124.30***	-0.10***	-123.80***
	(0.02)	(27.32)	(0.02)	(33.16)	(0.02)	(39.81)	(0.02)	(31.52)
Graduate education	0.01	50.59*	0.01	52.13	0.01	50.58	0.01	51.69
	(0.02)	(27.38)	(0.02)	(34.69)	(0.03)	(42.95)	(0.02)	(31.69)
Brahmin	-0.03*	-52.95**	-0.03*	-53.25**	-0.03*	-52.93**	-0.03*	-53.19**
	(0.02)	(26.56)	(0.02)	(26.64)	(0.02)	(26.69)	(0.02)	(26.68)
Forward	-0.01	-13.03	-0.01	-13.27	-0.01	-13.06	-0.01	-13.06
	(0.01)	(19.88)	(0.01)	(20.21)	(0.01)	(20.67)	(0.01)	(20.08)
SC and ST	0.06***	84.48***	0.06***	84.01***	0.06***	84.49***	0.06***	84.12***
	(0.01)	(19.33)	(0.01)	(20.38)	(0.01)	(21.27)	(0.01)	(20.17)
Muslim	-0.05***	-62.06***	-0.05***	-62.28***	-0.05***	-62.10***	-0.05***	-62.07***
	(0.01)	(19.51)	(0.01)	(21.58)	(0.02)	(22.50)	(0.01)	(20.89)
Christian and others	-0.01	-9.83	-0.01	-9.76	-0.01	-9.70	-0.01	-10.19
	(0.02)	(37.99)	(0.02)	(37.99)	(0.02)	(37.98)	(0.02)	(37.94)
Observations	4,612	4,612	4,612	4,612	4,612	4,612	4,612	4,612
Uncensored		553		553		553		553
Pseudo-R2	0.097	0.024						

Notes: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Standard errors are reported in parentheses.
Woman specific control variables: age at marriage, age, age square, average regional natural log of wage rate, marital status (married versus divorced and widowed), urban place of residence, childhood place of residence if urban, educational attainments: primary, secondary, post-secondary graduation and no education is base category, caste: Brahmin, Forward class, SC and ST, Muslim, Christian and others and OBC is considered as base category, land (i.e., wealth) and the regions of India: Northern, North-Eastern, Central, Eastern, Western.
Refer to Appendix Table 3.10 for the first stage regression results.
Source: Estimates are based on author's own calculation using the IHDS-II dataset.

A3.49. Probit & Tobit: Effect of school-aged on female labour market outcomes in the extended family setting

Mother Age 22-62	Probit Part. ME	Tobit Hours ME	IVProbit Twins Part. ME	IVTobit Twins Hours ME	IVProbit FG Part. ME	IVTobit FG Hours ME	IVProbit Twins FG Part. ME	IVTobit Twins FG Hours ME
Main variable:								
No. of children	0.00	0.18	0.00	-0.62	0.00	-1.69	0.00	-2.46
	(0.01)	(11.57)	(0.06)	(94.91)	(0.05)	(82.14)	(0.04)	(62.02)
Economic variables:								
Log wage rate	0.55***	823.27***	0.55***	821.40***	0.54***	815.46***	0.54***	814.27***
	(0.10)	(159.75)	(0.12)	(196.56)	(0.11)	(189.39)	(0.11)	(177.17)
Land ownership (0/1)	-0.09***	-178.38***	-0.09***	-178.15***	-0.09***	-178.96***	-0.09***	-178.55***
	(0.02)	(25.87)	(0.02)	(25.95)	(0.02)	(25.96)	(0.02)	(25.95)
Demographic variables:								
Age at marriage	-0.00*	-4.08	-0.00	-4.14	-0.00	-4.11	-0.00	-4.19
	(0.00)	(3.40)	(0.00)	(5.59)	(0.00)	(5.08)	(0.00)	(4.41)
Age of mother	0.02**	41.44**	0.02	41.57	0.02	41.09	0.02	41.33
	(0.01)	(16.44)	(0.02)	(34.38)	(0.02)	(31.00)	(0.02)	(25.68)
Age mother square	-0.00*	-0.50**	-0.00	-0.50	-0.00	-0.49	-0.00	-0.50
	(0.00)	(0.22)	(0.00)	(0.45)	(0.00)	(0.41)	(0.00)	(0.34)
Married	-0.17***	-313.99***	-0.17***	-313.58***	-0.17***	-311.39***	-0.17***	-311.25***
	(0.03)	(40.11)	(0.03)	(53.66)	(0.03)	(51.92)	(0.03)	(46.89)
Urban	-0.13***	-165.58***	-0.13***	-165.27***	-0.13***	-166.25***	-0.13***	-165.73***
	(0.02)	(29.33)	(0.02)	(29.87)	(0.02)	(29.83)	(0.02)	(29.74)
Childhood in urban	-0.01	-19.75	-0.01	-19.48	-0.01	-20.09	-0.01	-19.68
	(0.02)	(31.02)	(0.02)	(31.12)	(0.02)	(31.00)	(0.02)	(31.02)
Primary	-0.07***	-93.49***	-0.07***	-93.30***	-0.07***	-93.43***	-0.07***	-93.19***
	(0.02)	(29.34)	(0.02)	(29.83)	(0.02)	(29.72)	(0.02)	(29.53)
Secondary	-0.18***	-272.28***	-0.18***	-272.22***	-0.18***	-272.73***	-0.18***	-272.56***
	(0.02)	(28.23)	(0.02)	(32.94)	(0.02)	(31.71)	(0.02)	(30.35)
Post sec. education	-0.11***	-88.77*	-0.11***	-88.64	-0.11***	-89.44	-0.11***	-89.16*
	(0.03)	(47.36)	(0.03)	(57.56)	(0.03)	(54.42)	(0.03)	(51.54)
Graduate education	0.02	137.69***	0.02	137.28**	0.02	136.37**	0.02	136.03**
	(0.03)	(52.51)	(0.04)	(61.86)	(0.03)	(60.17)	(0.03)	(56.88)
Brahmin	-0.12***	-187.49***	-0.12***	-187.90***	-0.12***	-187.48***	-0.12***	-188.04***
	(0.03)	(39.41)	(0.03)	(39.68)	(0.03)	(39.75)	(0.03)	(39.68)
Forward	-0.08***	-114.74***	-0.08***	-114.94***	-0.08***	-114.77***	-0.08***	-115.03***
	(0.02)	(28.01)	(0.02)	(29.89)	(0.02)	(29.73)	(0.02)	(29.10)
SC and ST	0.12***	190.82***	0.12***	190.55***	0.12***	190.26***	0.12***	189.98***
	(0.02)	(29.97)	(0.02)	(32.07)	(0.02)	(31.36)	(0.02)	(30.77)
Muslim	-0.09***	-125.25***	-0.09***	-125.62***	-0.09***	-124.63***	-0.09***	-125.23***
	(0.02)	(35.02)	(0.03)	(43.94)	(0.03)	(42.05)	(0.03)	(39.30)
Christian and others	-0.11***	-143.38***	-0.11***	-143.63***	-0.11***	-143.93***	-0.11***	-144.17***
	(0.03)	(50.34)	(0.03)	(50.90)	(0.03)	(50.77)	(0.03)	(50.56)
Observations	4,155	4,155	4,155	4,155	4,155	4,155	4,155	4,155
Uncensored		1,123		1,123		1,123		1,123
Pseudo-R2	0.154	0.030						

Notes: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Standard errors are reported in parentheses.
Woman specific control variables: age at marriage, age, age square, average regional natural log of wage rate, marital status (married versus divorced and widowed), urban place of residence, childhood place of residence if urban, educational attainments: primary, secondary, post-secondary graduation and no education is base category, caste: Brahmin, Forward Class, SC and ST, Muslim, Christian and others and OBC is considered as base category, land (i.e., wealth) and the regions of India: Northern, North-Eastern, Central, Eastern, Western.
Refer to Appendix Table 3.10 for the first stage regression results.
Source: Estimates are based on author's own calculation using the IHDS-II dataset.

A3.50. 2SLS: Effect of both type of children (0–5 year and 6–17 year) on female labour market outcomes

Mother Age 19-60	LPM Part.	OLS Hours	2SLS Twins Part.	2SLS Twins Hours	2SLS FG Part.	2SLS FG Hours	2SLS Twins & FG Part.	2SLS Twins & FG Hours
No. of children	0.00	-7.98	-0.11***	-105.68*	0.07	87.29	-0.03	-18.01
	(0.01)	(8.32)	(0.04)	(57.23)	(0.05)	(70.94)	(0.03)	(43.52)
Log wage rate	0.57***	823.98***	0.46***	729.87***	0.64***	915.74***	0.54***	814.31***
	(0.12)	(196.60)	(0.12)	(204.98)	(0.13)	(207.56)	(0.12)	(200.08)
Land ownership (0/1)	-0.08***	-137.80***	-0.09***	-140.90***	-0.08***	-134.77***	-0.08***	-138.12***
	(0.01)	(20.17)	(0.01)	(20.39)	(0.01)	(20.50)	(0.01)	(20.18)
Age at marriage	-0.01***	-4.60	-0.02***	-12.40**	-0.00	3.00	-0.01***	-5.40
	(0.00)	(3.47)	(0.00)	(5.76)	(0.00)	(6.67)	(0.00)	(4.89)
Age of mother	0.03**	31.43*	0.06***	59.40***	0.01	4.16	0.03**	34.30*
	(0.01)	(16.20)	(0.02)	(22.88)	(0.02)	(26.07)	(0.01)	(20.10)
Age mother square	-0.00*	-0.36	-0.00***	-0.66**	-0.00	-0.08	-0.00**	-0.39
	(0.00)	(0.24)	(0.00)	(0.30)	(0.00)	(0.33)	(0.00)	(0.27)
Married	-0.17***	-422.48***	-0.17***	-419.87***	-0.17***	-425.02***	-0.17***	-422.21***
	(0.06)	(103.30)	(0.06)	(103.83)	(0.06)	(103.90)	(0.06)	(103.09)
Urban	-0.16***	-168.71***	-0.17***	-180.79***	-0.15***	-156.94***	-0.16***	-169.95***
	(0.01)	(24.86)	(0.02)	(25.82)	(0.02)	(26.28)	(0.02)	(25.23)
Childhood in urban	-0.04**	-33.14	-0.04**	-33.64	-0.04**	-32.64	-0.04**	-33.19
	(0.01)	(24.27)	(0.02)	(24.47)	(0.01)	(24.35)	(0.01)	(24.20)
Primary	-0.04**	-4.10	-0.07***	-29.60	-0.02	20.76	-0.05**	-6.72
	(0.02)	(24.65)	(0.02)	(28.96)	(0.02)	(31.27)	(0.02)	(27.06)
Secondary	-0.13***	-110.62***	-0.18***	-152.17***	-0.10***	-70.11*	-0.14***	-114.89***
	(0.02)	(22.21)	(0.02)	(32.70)	(0.03)	(37.54)	(0.02)	(28.62)
Post sec. education	-0.10***	27.34	-0.18***	-40.67	-0.05	93.66	-0.12***	20.36
	(0.02)	(47.29)	(0.04)	(63.13)	(0.04)	(68.88)	(0.03)	(56.99)
Graduate education	0.02	258.74***	-0.07	184.59**	0.07	331.04***	-0.00	251.12***
	(0.03)	(70.23)	(0.04)	(81.91)	(0.05)	(90.63)	(0.04)	(78.13)
Brahmin	-0.06**	-36.59	-0.07**	-38.94	-0.06**	-34.31	-0.06**	-36.84
	(0.03)	(46.51)	(0.03)	(47.02)	(0.03)	(46.39)	(0.03)	(46.40)
Forward	-0.04**	-66.92**	-0.06***	-76.41***	-0.04**	-57.67**	-0.05***	-67.90**
	(0.02)	(27.26)	(0.02)	(28.49)	(0.02)	(28.15)	(0.02)	(27.72)
SC and ST	0.15***	194.36***	0.16***	203.52***	0.15***	185.43***	0.16***	195.30***
	(0.02)	(23.01)	(0.02)	(23.74)	(0.02)	(24.10)	(0.02)	(23.29)
Muslim	-0.12***	-99.65***	-0.06***	-53.48	-0.15***	-144.68***	-0.10***	-94.91***
	(0.02)	(23.88)	(0.02)	(36.32)	(0.03)	(40.60)	(0.02)	(31.06)
Christian and others	-0.03	13.71	-0.04	6.04	-0.02	21.19	-0.03	12.92
	(0.04)	(75.53)	(0.04)	(75.51)	(0.04)	(76.02)	(0.04)	(75.29)
Observations	5,287	5,287	5,287	5,287	5,287	5,287	5,287	5,287
R-squared	0.141	0.099	0.087	0.080	0.118	0.081	0.138	0.099
F-statistics			59.76	59.76	90.50	90.50	74.58	74.58

Notes: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Standard errors are reported in parentheses.
Woman specific control variables: age at marriage, age, age square, average regional natural log of wage rate, marital status (married versus divorced and widowed), urban place of residence, childhood place of residence if urban, educational attainments: primary, secondary, post-secondary graduation and no education is base category, caste: Brahmin, Forward Class, SC and ST, Muslim, Christian and others and OBC is considered as base category, land (i.e., wealth) and the regions of India: Northern, North-Eastern, Central, Eastern, Western.
In the first stage regression, the effect of twins on fertility is 1.20, statistically significant at the 1 percent level.
Source: Estimates are based on author's own calculation using the IHDS-II dataset.

A3.51. Reasoning behind the decline in hours of labour supply for women due to increase in *fertility* (or, increase in the compulsory housework time)

From the time constraint: $N = (T - L - H)$ where $H = \bar{H}' + H_H$ and $\bar{H}' > 0$ and $H_H \geq 0$
Wage income: $WN = W(T - L - H)$

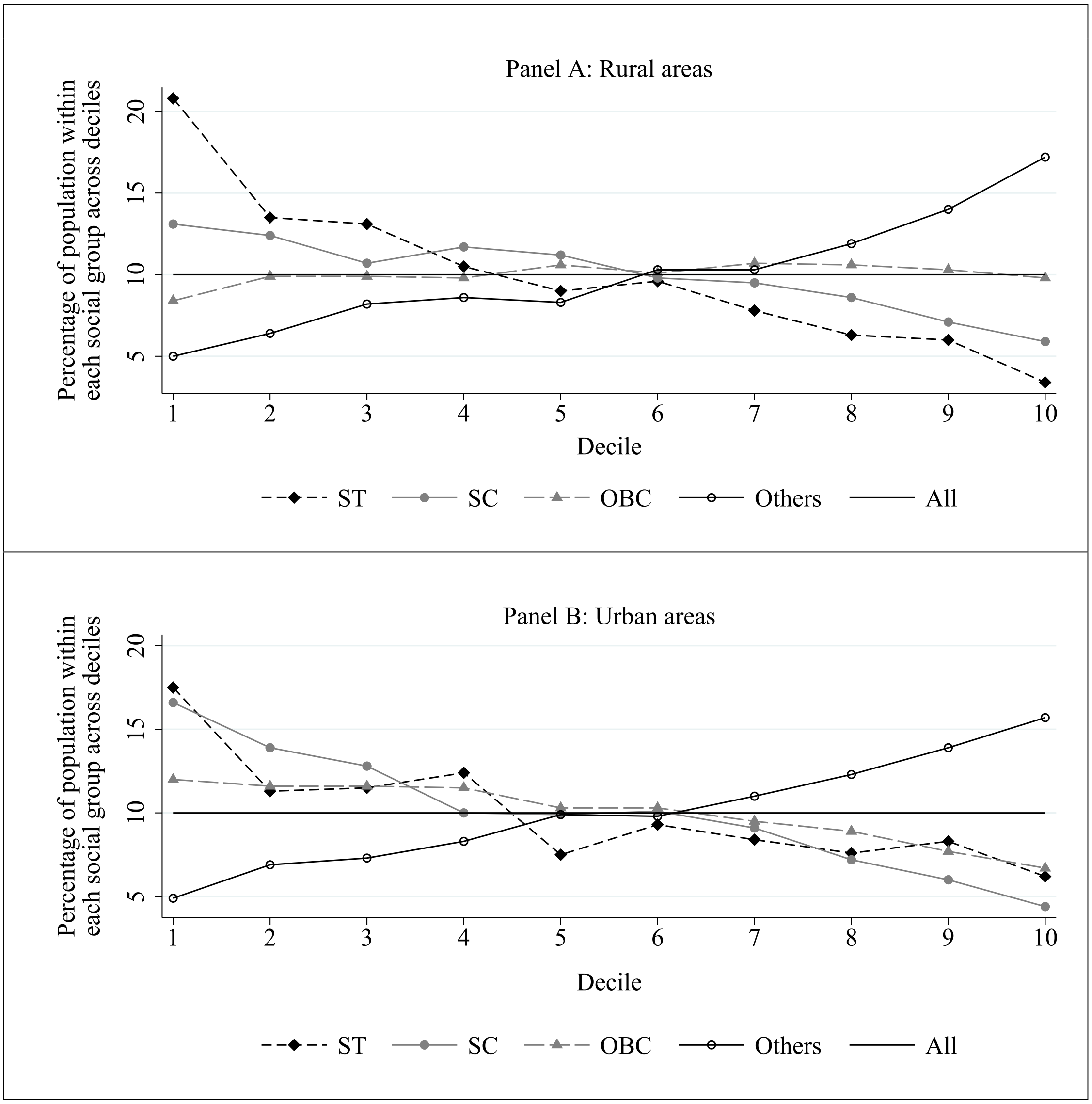
Income Effect:
As H increases due to increase in $\bar{H}$ such that $\bar{H}' > \bar{H}$, keeping other things unchanged, wage income declines
As wage income declines, both L and X falls because both X and L are normal goods by assumption.

Direction and magnitude of changes in L and N:
From the time constraint: $(N + L) = (T - H)$. As H increases, $(N + L)$ declines. To understand the direction and the magnitude of the change in N and L corresponding to rise in H, I explore the following possibilities:

Case a	N remaining constant, decline in L is equal to rise in H)	Not Feasible	As wage income declines, if X_M remains constant due to constant N then, X_M becomes inferior good violating the assumption
Case b	Both N & L decline, but the magnitude of decline in each N & L is less than rise in H	**Feasible**	As wage income declines, if X_M declines due to fall in N then X_M remains a normal good and L also declines, so, L remains a normal good
Case c	N declines by the same amount of rise in H but L remains constant	Not Feasible	As wage income declines, if X_M declines due to fall in N then X_M remains normal good but if L remains constant then it will not be a normal good but an inferior good violating the assumption
Case d	Corresponding to rise in H, if decline in N is larger than the rise in L	Not Feasible	As wage income declines, if X_M declines due to fall in N then X_M remains normal good but if L rises then L will become inferior good violating the assumption
Case e	Corresponding to the rise in H, if rise in N is less than the decline in L	Not Feasible	As wage income declines, if X_M rises due to rise in N then X_M will become an inferior good, violating the assumption, although L remains a normal good

Source: Author's own presentation.

A4.1. Distribution of population across deciles by social groups within the rural areas and within the urban areas in India, 2011–12



Notes: While generating each diagram (Panel A and Panel B), the respective sample population (All) is first divided into ten deciles by Monthly Per Capita Consumption Expenditures (MPCE). For example, in Panel A, the entire rural sample population is first divided into ten equal groups by MPCE, so that each decile contains 10% of the sample population. Decile 1 forms the poorest group, whereas decile 10 forms the richest group. The distribution of the sample population for each social group is computed across these ten deciles.

ST: Scheduled Tribes; SC: Scheduled Castes; OBC: Other Backward Classes; Others: General.

Source: The figures have been generated using the data available in Statement 3.5 of NSS (2015).

A4.2. Comparing household characteristics between the migrants and the non-migrants

SC/ST	State of origin (Non-migrant)	Other state (Migrant)	Difference in Mean	
Has caste certificate	0.63	0.42	0.20	(0.000)
Head's age	48.28	48.64	-0.36	(0.759)
Head education	5.86	5.15	0.71	(0.108)
Average adult education age[1]	7.37	6.51	0.85	(0.009)
Average age of adult[1]	36.49	36.58	-0.09	(0.890)
Head is female	0.22	0.20	0.03	(0.513)
Household size	4.62	5.02	-0.40	(0.070)
Child dependency ratio	0.18	0.22	-0.05	(0.010)
Adult dependency ratio	0.04	0.04	0.00	(0.766)
Observations	224	188	412	
OBC	**State of origin (Non-migrant)**	**Other state (Migrant)**	**Difference in Mean**	
Has caste certificate	0.53	0.31	0.21	(0.000)
Head's age	51.78	46.50	5.28	(0.000)
Head education	6.72	7.74	-1.02	(0.055)
Average adult education age[1]	8.87	8.23	0.64	(0.086)
Average age of adult[1]	37.61	35.90	1.71	(0.030)
Head is female	0.26	0.10	0.16	(0.001)
Household size	4.74	5.11	-0.37	(0.131)
Child dependency ratio	0.17	0.21	-0.04	(0.080)
Adult dependency ratio	0.06	0.03	0.02	(0.064)
Observations	135	140	275	
SC/ST & OBC	**State of origin (Non-migrant)**	**Other state (Migrant)**	**Difference in Mean**	
Has Caste Certificate	0.59	0.38	0.21	(0.000)
Head's age	49.60	47.73	1.87	(0.042)
Head education	6.18	6.25	-0.07	(0.837)
Average adult education age[1]	7.93	7.25	0.69	(0.007)
Average age of adult[1]	36.91	36.29	0.62	(0.222)
Head is female	0.24	0.16	0.08	(0.007)
Household size	4.66	5.06	-0.39	(0.016)
Child dependency ratio	0.17	0.22	-0.05	(0.002)
Adult dependency ratio	0.05	0.03	0.01	(0.158)
Observations	359	328	687	

Notes: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Two-sided p-values are reported in parentheses. This table presents descriptive statistics for households by their caste status. [1]The adult members are aged between 18–65 years.
Source: Estimates are based on authors' calculations using the survey data.

A4.3. Effect of the instrument on the possession of a caste certificate (First stage regression)

	Caste certificate		
	SC/ST	OBC	SC & OBC
Non-migrants (IV)	0.165^{***}	0.201^{***}	0.174^{***}
Observations	412	275	687
F-Statistic	12	11	22

Notes: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$. Two-sided p-values are reported in parentheses.
This table presents the first stage regression results. Controls for household level analysis include average education of all working aged household members (i.e., who are between the ages of 18–65 years) and its square, average age of all working aged household members (i.e., who are between the ages of 18–65 years) and its square, gender of household head, effective household size, adult dependency ratio, child dependency ratio, city dummy variable for Kolkata (considering Mumbai as a base dummy).
Source: Estimates are based on authors' calculations using the survey data.

A4.4. Determinants of the caste certificate holding and validity of the instrument: Testing the direct impact of the instrument on the outcomes variables

Dependent Variables:	Caste Certi. LPM	MIA OLS	HH Govt.Job at least one LPM
Non-migrants (IV)	0.174***	0.009	0.035
SC (base: OBC)	0.199***	-0.033*	0.065*
Average Adult Education Age 18-65	0.044*	0.016*	-0.009
Avg. Adult Edu. Square	-0.000	0.000	0.001
Average age of adult between 18-65	0.028	0.009	0.002
Avg. Adult Age Square	-0.000	-0.000	0.000
Head is female	-0.066	-0.019	0.011
Household size	0.010	-0.012***	0.012
Child dependency ratio	0.060	-0.044	-0.056
Adult dependency ratio	0.012	-0.007	0.157
Kolkata	-0.100*	-0.102***	-0.074**
Has Caste Certificate		0.026	0.039
Observations	687	687	687
R^2	0.144	0.305	0.042

Notes: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Two-sided p-values are reported in parentheses. The first column of the table presents determinants of caste certificate. Second and third columns show that the instrument (i.e., non-migrants or residing the a *state of origin*) has no direct impact on outcome variables of interest, namely MIA scores and government jobs. Controls for household level analysis include average education of all working aged household members (i.e., who are between the ages of 18–65 years) and its square, average age of all working aged household members (i.e., who are between the ages of 18–65 years) and its square, gender of household head, effective household size, adult dependency ratio, child dependency ratio, city dummy variable for Kolkata (considering Mumbai as a base dummy).
Source: Estimates are based on authors' calculations using the survey data.

A4.5. Validity of the instrument: Testing the direct impact of the instruments on the MIA components

LPM	Components of MIA Score									
	Water facility SC/ST	Personal toilet SC/ST	Saving account SC/ST	No chronic disease or disability SC/ST	House quality SC/ST	No house -leak SC/ST	No room over-crowd SC/ST	No exposure to health hazard SC/ST	No. of assets SC/ST	Land-line or Mobile SC/ST
Non-migrants (IV)	-0.000	0.015	-0.026	0.112**	-0.016	0.053	-0.012	-0.056	0.015	-0.058
Observations	412	412	412	412	412	412	412	412	412	412
LPM	OBC	OBC	OBC	OBC	OBC	OBC	OBC	OBC	OBC	OBC
Non-migrants (IV)	-0.027	-0.031	-0.027	0.091*	0.013	0.086	-0.007	0.070	0.171***	0.006
Observations	275	275	275	275	275	275	275	275	275	275
LPM	SC/ST & OBC	SC/ST & OBC	SC/ST & OBC	SC/ST & OBC	SC/ST & OBC	SC/ST & OBC	SC/ST & OBC	SC/ST & OBC	SC/ST & OBC	SC/ST & OBC
Non-migrants (IV)	-0.007	-0.004	-0.030	0.103***	-0.006	0.056	-0.017	-0.013	0.069*	-0.037
Observations	687	687	687	687	687	687	687	687	687	687

Notes:***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Two-sided p-values are reported in parentheses.
The table shows that the instrument does not have any direct impact on attainment indicators except for two indicators namely no chronic disease or disability and having health insurance; the number of asset ownership. Controls for household level analysis include average education of all working aged household members (i.e., who are between the ages of 18–65 years) and its square, average age of all working aged household members (i.e., who are between the ages of 18–65 years) and its square, gender of household head, effective household size, adult dependency ratio, child dependency ratio, city dummy variable for Kolkata (considering Mumbai as a base dummy).
Source: Estimates are based on authors' calculations using the survey data.

A4.6. Mediation analysis: MIA components

Panel I. Dep. variables:	Govt. Job: 2SLS		
	SC & OBC	OBC	SC
Caste Certificate	0.238*	0.395**	0.086
	(0.062)	(0.044)	(0.341)
Panel II. Dep. variables:	(1) Mediation Analysis: Improved water		
Govt. Job (Mediator)	0.037	0.001	0.173
	(0.390)	(0.498)	(0.372)
	(2) Mediation Analysis: Have personal toilet		
Govt. Job (Mediator)	-0.005	-0.031	-0.018
	(0.483)	(0.407)	(0.483)
	(3) Mediation Analysis: Have bank account		
Govt. Job (Mediator)	0.282***	0.134*	0.876**
	(0.008)	(0.059)	(0.032)
	(4) Mediation Analysis: Improved house-type		
Govt. Job (Mediator)	-0.088	0.047	-0.556
	(0.289)	(0.386)	(0.143)
	(5) Mediation Analysis: MIA component (No house leak)		
Govt. Job (Mediator)	0.197	0.213*	0.295
	(0.114)	(0.091)	(0.312)
	(6) Mediation Analysis: No over-crowd)		
Govt. Job (Mediator)	-0.034	-0.155	0.222
	(0.415)	(0.141)	(0.337)
	(7) Mediation Analysis: No health hazard		
Govt. Job (Mediator)	0.302**	0.306**	0.461
	(0.015)	(0.005)	(0.172)
	(8) Mediation Analysis: At least a landline		
Govt. Job (Mediator)	0.154	0.302**	-0.267
	(0.151)	(0.025)	(0.300)
Observations	687	275	412

Notes: Notes: One sided p-values are reported in parentheses.
Panel I presents regression of caste certificate on government job holding by at least a member in an *eligible* household and a set of control variables. The predicted value of government job is obtained from the regression equations for SC/ST, OBC and combined groups.
Panel II presents regression results for having a government job on MIA components. The predicted value of government job obtained in Panel I is used in Panel II regressions. The estimates are computed using a bootstrap method with 1,000 replications.
Controls for household level analysis include average education of all working aged household members (i.e., who are between the ages of 18–65 years) and its square, average age of all working aged household members (i.e., who are between the ages of 18–65 years) and its square, gender of household head, effective household size, adult dependency ratio, child dependency ratio, city dummy variable for Kolkata (considering Mumbai as a base dummy).
Source: Estimates are based on authors' calculations using the survey data.